A MANAGEMENT INFORMATION SYSTEM FOR THE REVOLVING FUND MANAGER

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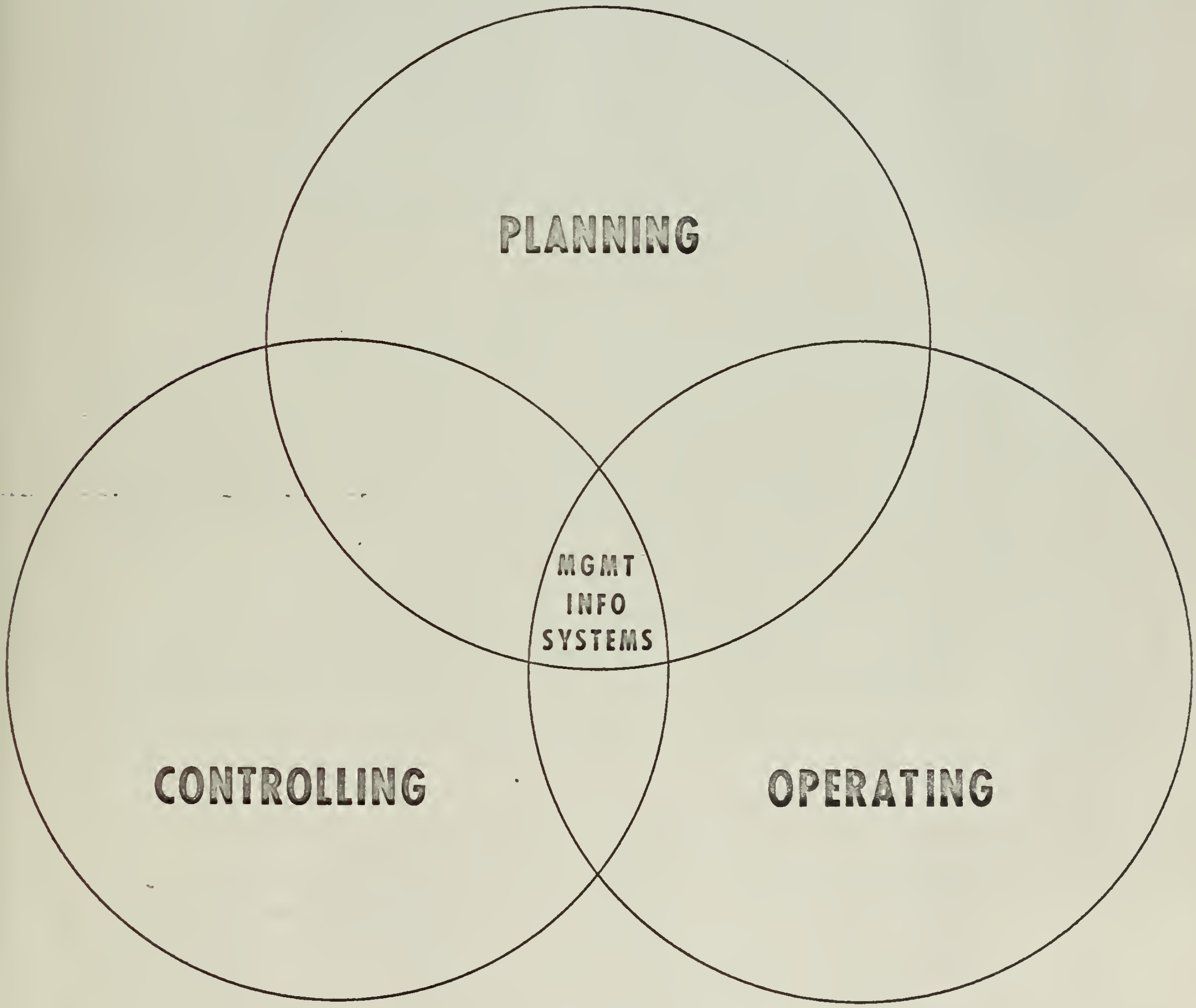
PLANNING
REAL
TIME
SYSTEMS
CONTROLLING
OPERATING

"When a man has confidence he gets along in business, but without confidence he might just as well not enter business at all. For confidence is the son of vision, and is sired by information."

Cornelius Vanderbilt, Jr.



PREFACE

In the past few years considerable effort has been devoted to the complex task of improving management controls. Efforts toward identifying managerial functions, increasing managerial ability, and improving managerial performance have assumed new importance in civilian industry and in the federal government. Rising costs, foreign competition, customers' demands for increased quality and reliability, and the very increased complexity of doing business are causing business enterprises to seek new systems to improve their planning and organization.

Electronic data processing has improved management's capability and provided a flexibility never before realized. To be able to allocate resources consistent with the relative importance of needs is an essential responsibility of the manager. Few organizations have an effective management information system to aid them in maximizing the utilization of available resources and there are few managers who are making effective use of electronic computers to solve their management problems.

This paper attempts to define what the ingredients of an effective management information system are and how top management in a revolving fund organization can utilize the system to accomplish the mission or goals of the organization.

In general, the basic information needs of top executives in all industries are so similar that some useful generalizations can be derived. This is true even though the needs are frequently so encumbered with a specific application that their key features are not apparent. The author has not attempted to delve into the structures of the many varied revolving fund organizations, but has used a hypothetical revolving fund for the management of electronic data processing equipment as the framework from which an executive could develop his management information system.

The research for this paper consisted of personal interviews with people in the field of information systems, an examination of current literature and official government documents, and the personal experience and observations of the author drawn from sixteen years of active duty as a commissioned officer in the Supply Corps of the United States Navy.

Chapter I appraises the importance of an information system to an organization and reviews the criteria for an effective management information system to improve management controls.

Chapter II outlines management's role in the development of an information system and discusses general information requirements.

Chapter III defines the revolving fund organizational

concept and discusses its values and limitations within the federal government.

Chapter IV analyzes the responsibility of the revolving fund manager for automatic data processing equipment in the federal government and sets forth minimum information requirements for administration of the organization.

Chapter V presents a brief summary of the paper and the conclusions reached by the author.

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INTRODUCTION

A management information system is a communication system in which relevant data is processed to support management decisions for planning, operating and controlling. The system refers to the complete cycle, covering the acquisition of data at the source, its transmission through communications links, its processing with computational devices, and its ultimate utilization. A management information system accumulates, organizes, manipulates, stores and transmits data to relevant people in the organization.[1] Data is only potential information until it is transmitted in the form of reports, lists, documents, or instructions.

Every member of an organization, to some degree, accumulates, transfers, uses or stores information in one form or another. Recent studies in both the United States and Europe indicate that up to 90% of the work involved in any white-collar job involves the seeking and obtaining of information. Since 90% of man-hours and salaries are consumed in processing information, it is important that management seeks and continues to seek improvements in the concepts and techniques of this system. Each breakthrough

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[1] Adrian M. McDonough and Leonard J. Garrett, Management Systems: Working Concepts and Practices (Homewood, Ill.: Richard D. Irwin, Inc., 1965), p. 4.

in this area can yield impressive payoffs.[2]

Rising costs, competition in the marketplace, customers' demands for better quality, and the increased complexity of doing business because of federal and state regulation are causing business enterprises to seek new systems to improve their organizations. The mounting requirements and costs of operating a business make it mandatory that the best concepts and techniques be used for business planning and control. Management's chief task is to consolidate internal and external information in a process of continual control and planning for the future.

A total management information system automatically controlling an entire organization is not envisioned in the forseeable future, but a system capable of keeping the managerial personnel completely informed of all developments is conceivably possible of achievement. It must be noted, however, that no organization has yet developed a complete and entirely satisfactory management information system, even for its internal operations, although a few companies are far ahead in this endeavor.[3]

The transition to a highly technological society has confronted management with confounding interrelationships and complexities that by some means must be coordinated to be meaningful. New possibilities for coordinating and controlling complex and voluminous data and events are

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[2] Ibid., p.6.

[3] James D. Gallagher, Management Information Systems and the Computer (New York: American Management Association, 1961), p. 16.

now available with the advent of electronic data processing.[4] Schultz and Whisler point out that:

> The characteristics of the computer are such that its use makes possible an enormous increase in the amount of information considered, in the range of alternatives explored and in the speed of exploration in each decision situation. It should be possible, then, for management to do a much better job of coordinating various aspects of the firm's operations and assessing the impact of a decision...[5]

It is common knowledge that the state of the equipment available today exceeds the capability of managers to employ it fully. On this point Gerald Phillippe has said:

> There is a frighteningly common desire to prove that incredible amounts of information can be developed with electronic devices by preparing business reports that are incredibly long, incredibly dull, and all in all, just plain incredible. Information alone is not enough. Try visualizing, for example, one of our big daily newspapers if it was presented straight off the wire in continuous columns, with no headlines, no attempt to avoid duplication, and no simple means of judging the relative importance of the various news stories or putting them in proper perspective. Would you even attempt to read such a paper? I think not. Yet management is frequently forced to hunt through a haystack of irrelevant information in its reports in order to find for itself the needle of pertinent fact. What is needed, obviously, is a planned system of business intelligence ---or, as the author of this report prefers to call it ---a "management information system" which selects, rejects, edits, and headlines business information--- in short, which turn it into business intelligence.[6]

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[4] Albert R. Hoffman, "Management Information Systems and the U.S. Army Autoprobe System" (Unpublished Master's Thesis No. 80, Industrial College of the Armed Forces, 1964), Abstract.

[5] George P. Schultz and Thomas L. Whisler (eds.), Management Organization and the Computer (Chicago: University of Chicago Press, 1960), pp. 7-8.

[6] Gerald L. Phillippe, "What Management Really Wants From Data Processing," Data Processing Today: A Progress Report, Management Report No. 46 (New York: American Management Ass'n, 1960), pp. 11-12.

All levels of management face the danger of becoming so fascinated by the lure of office automation that they lose sight of a far greater need to develop their acumen in determining what information is of real worth.[7] Electronic data processing systems are not just adding to current techniques of doing business but are completely replacing many of them.

The federal government pioneered in the development and use of automatic data processing. The Bureau of the Census, staggered with the problem of collecting, processing, and summarizing huge quantities of information, was using mechanical data processing equipment prior to 1900. In 1954 there were ten government computer installations; today there are about 6,000 computers funded by the federal government with expenditures approaching $3 billion.[8]

Public Law 89-306 established a revolving fund under the management of the General Services Administration to obtain the maximum benefits from the automatic data processing resources of the federal government. This law is the first public law passed for the purpose of improving the management of automatic data processing equipment in the federal government. Although Public Law 89-306 was passed in 1965 the revolving fund organization within the General Services Administration is not yet in operation. An organization

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[7] Gallagher, 48.

[8] Carl W. Clewlow, "Management of Automatic Data Processing in Government," The Armed Forces Comptroller, X (March, 1965), p. 19.

of this type will be unique within the General Services Administration but it should provide greater simplicity in the financing and funding structure and greater flexibility in operations.

A revolving fund is defined as, "a fund established to finance a cycle of operations to which reimbursements and collections are returned for reuse in a manner such as will maintain the principal of the fund..."[9] As a funding medium, the revolving fund simplifies the financing of business type operations. The mission of the fund is to provide end-products or services to customers of or within the federal government and to facilitate cross-servicing among the agencies of the federal government. These activities manifest in a high degree the problems of management characteristic of large scale industry.

The basic research question of this paper is to identify the requirements for an effective management information system and demonstrate how they can be applied to a revolving fund organization in the federal government. A revolving fund organization was selected because of its basic accounting structure, and because it lends itself to the effective businesslike techniques essential to the economic management and financing of operations. This structure

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[9] U.S. Department of the Navy, Office of the Comptroller. Navy Comptroller's Manual, Vol. I, Appendix a, p. a-16.

is similar to that used in civilian industry and is the antithesis of the cumbersome and sometimes fact-obscuring mechanisms of allotment and sub-allotment controls used in the government.

Subsidiary questions to be covered are the details and interrelationships of functional tasks, management decisions, organization structure, information flows, and data processing in an organization with an effective management information system. Management's objective is to tie together all operations, no matter how ramified, into one coherent management network that provides meaningful intelligence for making decisions.

It is not within the scope of this paper to discuss the management functions of strategic planning, management control and operational control for this particular revolving fund organization. A full consideration of this process would mean stepping into the subject of business management. It is the purpose of this paper, instead, to appraise the management functions as they apply generally to management information systems in all organizations and to outline the key result areas from which detailed information needs may be derived within a revolving fund organization.

CHAPTER I

MANAGEMENT INFORMATION SYSTEMS

Characteristics

The major reasons for the growth of management information systems in recent years are the need to control paperwork and clerical costs, and the decentralization by many firms of most of their operations. The size and complexity of today's business enterprises have significantly changed the basis on which decisions can be made. The entrepreneur, or single decision-maker at the head of an enterprise, can no longer function effectively in today's dynamic business environment. The distance between the decision maker and the market place has increased and created a much greater dependence on the formal organization. The timely flow of production and market information and its intelligent interpretation by the corporation's staff of specialists are now vital.[1]

In recent years the decentralization of operations pursued by many companies has highlighted the need for timely information with which to evaluate the effectiveness of their divisions. In the words of Richard Neuschel·

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[1] Gallagher, 45.

> If decentralization is to mean delegation rather than abdication, then the executive who used to "run the whole show" himself must learn instead how to evaluate the way someone else is running it.[2]

It is virtually impossible to design a complete information system, tailored to one company, that can be applied and used effectively in any other firm. The first and most essential step in developing a system for a particular organization is to determine the exact needs of management for planning and control reports. With this information the programs for the electronic data processing can be developed by the systems analysts, the data processing people, and the firm's management in a coordinated effort.[3]

The characteristics that should be inherent in a management information system designed to provide the required intelligence are as follows:

1. It must facilitate planning and control and provide top management with a comprehensive understanding of those factors, both internal and external, which influence the operations of the enterprise---it must enable managers to carry out their delegated responsibility in conformance with total corporate objectives.

2. It must provide performance measurement factors

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[2] Richard F. Neuschel, Management By System (New York: McGraw-Hill Book Co., 1960), p. 205.

[3] Gallagher, 16.

for all quantifiable functions, thereby furnishing management a means for a high level review of company operations.

3. It must provide the information requirements to all management levels for operational control of the entire organization structure.

4. It must provide the information necessary for the continued development and application of advanced scientific-management techniques.

5. It must be flexible in nature, capable of changing in the shifting socio-economic and political environment in which a dynamic business battles to survive.[4]

Bruce Garrett of the Army Missile Command avows that by 1970 the average, large scale management information systems will have the following characteristics that differentiate them from existing systems:

1. They will be real-time[5] information systems.
2. They will include graphic elements, display systems, fascimile and large files in the 10 to 100 billion bit range.
3. They will be communications-oriented, with the cost of the central computer being less than 30 per-

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[4] Norman J. Ream, "The Need for Compact Management Intelligence," Management Control Systems, eds. Donald G. Malcolm, Allan J. Rowe, and Lorimer F. McConnell (New York: John Wiley and Sons, 1960), p. 92.

[5] D. D. Sharp says, "The real-time system must be able to distinguish between the urgency of needs and satisfy each one as fast as desired...It involves gathering, processing and using data while the associated event is in progress." D.D. Sharp, Jr., "The Use of Real Time Computers for Inventory Control" (Unpublished Report prepared at University of Pennsylvania for U.S. Navy, 1964), p. 2.

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2. [illegible]

4. [illegible]

5. [illegible]

[illegible]

1. [illegible]
2. [illegible]
3. [illegible]

[illegible]

[illegible]

> cent of the total system.
>
> 4. In many cases, they will be industry-oriented, or tailor made for the industry on the basis of special purpose peripheral equipment.[6]

The American Telephone and Telegraph Company appears to reinforce Garrett's prediction about communications when it states that it expects communication between machines in different cities to exceed voice communication over telephone lines by 1970.[7]

John Dearden points out the characteristics of information processing which exploit the strengths of the computer as follows:

1. Interacting variables: Solving problems with many variables is facilitated by the computer's ability to rapidly perform mathematical and logical operations.

2. Reasonably accurate values: Reasonably accurate values must be assigned the coefficients of the equations and the equations must accurately express the relationships between the variables.

3. Speed: The value of the computer is directly proportional to the need for speed. Useful information is obtainable which heretofore was useless because of time constraints.

4. Repetitive operations: Expensive programming

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[6] Bruce L. Garrett, "The Impact of ADP on the Future Managerial Environment" (Unpublished paper prepared for Redstone Scientific Information Center, Redstone Arsenal, Alabama, 1965), p. 13.

[7] *Ibid.*, 17.

[illegible]

6. [illegible]

The [illegible] Sinks in 1970.[7]

[illegible] information [illegible] as follows:

1. Information retrieval. [illegible]

2. [illegible] between the variables.

3. [illegible] statistics.

4. [illegible]

[illegible]

[7] [illegible] 1970, p. 17.

of the computer is justified when the processing of data is repetitive.

5. Need for accuracy: The utility of the computer varies with the accuracy required. If the input is inaccurate or the need for accuracy is slight then the computer is impractical.

6. Large amounts of information: The great speed of the computer permits the processing of a huge volume of data through repetitive operations.[8]

Within the context of these characteristics, operations research, systems planning and automated data processing can contribute to the objective of better management information and, thus, better management.

Objectives

Rensis Likert Says:

> If the goals of the organization are to be accomplished, the people making the decisions must have the interest of the organization at heart and must have before them all the relevant facts. These are prerequisites for sound decisions and the effective execution of those decisions.[9]

An effective management information system should provide objective information to management for measuring the performance of all financial and non-financial elements.

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[8] John Dearden, "Can Management Information be Automated?", Harvard Business Review, 42 (March-April, 1964), pp. 129-130.

[9] Rensis Likert, New Patterns of Management (New York: McGraw-Hill Book Co., Inc., 1961), p. 212.

An efficient system will provide information by which management may appraise the conformity of company operations to previously established standards or plans. The effectiveness of each major department or division can be determined and the operating division's contribution to the position of the firm in its industry can then be accurately measured. A helpful by-product of the system would be a quantitative basis for judging the performance of individual executives; admittedly, this is easier when the manager's job can be measured in terms of dollars and/or units of output.[10]

Another objective of an effective management information system is to facilitate the decision-making process by providing top management with a means of optimizing the goals of the organizational sub-units. This objective would, for example, emphasize the importance of packing and shipping information for the benefit of the entire company rather than for the interest of one division or department which would probably fail to take advantage of maximum consolidation and cost reduction.[11]

Information reporting should be geared to the level of management which would fully utilize it---the higher the executive, the broader, but briefer, the report. As the information system descends through the organization, the reports will contain much more data and will be more specialized in scope. Information usually becomes less quantified the

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[10] Gallagher, 63.
[11] *Ibid*.

higher it ascends in the organization since top management more than the lowest manager in the hierarchy is concerned with trends and comparisons. Mr. Harold Borko of the Systems Development Corporation in reply to John Dearden's article[12] commented:

> The key to effective management control is to know what questions to ask of the available information...The computer can (be programmed to) analyze the data and provide statistical summaries, trends, and correlation in terms of needed information and never present the basic data.[13]

The final, but very important objective is that the system should have the ability to furnish its data in the form required with a minimum of distracting and irrelevant material. The emphasis should be on minimum volume with maximum relevance.

Management Planning and Control

The growth of applied science and technology has been amply demonstrated in all the industrial nations of the world during the past fifty years and has illuminated the important questions and problems of our time as those of management decision-making and control. This evolutionary pace shows no signs of slackening and as a result, the problems of management planning and control will become even more important and complex. The existence of a wide knowledge

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[12] Can Management Information Systems Be Automated?", p. 133.

[13] Harold Borko, "The Thoughtful Businessman," Harvard Business Review, 42 (July-August, 1964), 40.

gap between the mathematician or "model maker", who is attempting to define and quantify, and the operator in the field, who is restricted by what he can physically accomplish, further increases the complexity of this problem. At this time, there is not much evidence that this gap is closing.[14]

One effect of this applied science and technology has been a shift in emphasis from day-to-day operations control to planning. This was pointed out by Jay Forrester of the Massachusetts Institute of Technology in developing an analogy between military and business evolution:

> As the pace of warfare has quickened, there has of necessity been a shift of emphasis from the tactical decision (moment-by-moment direction of the battle) to strategic planning (preparing for possible eventualities, establishing policy, and determining in advance how tactical decisions will be made.) Likewise in business: as the pace of technological change quickens, corporate management, even at the lower levels, must focus more and more on the strategic problems of running the business and less and less on the everyday operating problems.[15]

In 1959, Peter Drucker, noted management lecturer and consultant, who repeatedly stresses that management is "an action process," said this about managers:

> In dealing with their new tasks, the managers of the 1960's will, to a large extent, have to employ the same tools they are using today. But managers will also find,

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[14] G.F. Weinwurm, The Management of Information Processing, A Report to the Symposium on Economics of Automatic Data Processing, Rome, October 19-22, 1965, Prepared by Systems Development Corporation, Santa Monica, Calif., p. 3.

[15] Jay W. Forrester, "Industrial Dynamics: A Major Breakthrough for Decision Makers," Harvard Business Review, 36, (July-August, 1958), 39.

> increasingly, that they are expected to know, understand, and handle new concepts and tools of management. Increasingly, they will find that they are expected to use systematic methods of analysis and decision making, supplemented by new tools of communication, computation, and presentation.
>
> Executives can safely disregard all the fanciful talk about the computer "replacing managers" and "making decisions." Manager's work, it can be said with confidence, is going to become more important and their numbers larger. But the management sciences--such as operations research or decision-making logic---and the new electronic tools and systems are going to make a difference, even to the manager in the small business.
>
> And the manager of 1970 will need all the help he can get from such new concepts and tools. For this job is going to be so complex, so big, so demanding as to require all the tools of simplification and systematization that can possibly be obtained.[16]

The day of management by premonition and intuition is passing and management by facts is taking place in all levels of management.

An understanding of the basic processes of management is necessary to comprehend the characteristics and objectives to be included in an effective management information system. It is not sufficient for the systems manager to have a knowledge of systems techniques and electronic data processing equipment; he must also become a more astute disciple of management if he is to develop the ability to perceive the information requirements of management and to translate these needs into an efficient information program.

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[16] Peter F. Drucker, "The Next Decade in Management," Dun's Review and Modern Industry, 74, (December 1959), pp. 60-61.

John Dearden claims that one of the principal reasons for the inefficient utilization of computers by management is the failure to segregate management's functions in a meaningful manner. Typically, the hierarchy is comprised of top management and middle management---neither of which is rigidly defined because of the difficulty of their tasks. Dearden classifies management functions in the following order:

> Strategic planning, planning, which consists of (a) determining corporate policies and objectives; (b)deciding on any changes in these policies and objectives; and (c) deciding on the resources to be devoted to attaining these objectives.
> Management control, which consists of (a) dividing the strategic plans into logical subdivisions; (b) providing the funds to carry out the subdivisions of the plan; (c) assigning the responsibility for carrying out each of the subdivisions of the plan to some individual; and (d) following up to see that the assignment is being satisfactorily carried out.
> Operational control, which consists of (a) determining the specific men, equipment, material, and information necessary to accomplish the subdivision of the plan; (b) assigning these resources so that the plan can be carried out in the most efficient manner; and (c) comparing actual results with plans and taking corrective action where appropriate.[17]

It is possible, with the technical equipment presently on the market, to build a network for communications and data processing that would provide vastly improved information for executive planning and control in even the largest organization. The major effect would be to facilitate the decision-making

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[17] Dearden, 128.

[illegible]

> **Strategic planning**, [illegible]
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> **Management control**, [illegible]
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> **Operational control**, [illegible][17]

[illegible]

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[17] [illegible]

process by giving the manager accurate and timely information with which to measure more precisely the economic and operational consequences of a decision. However, the decision could not be programmed and the executives judgment and responsibility could not be transferred to the computer.[18] The rapid development of organizations under the impetus of high speed automatic data processing equipment has actually increased the requirement for effective human operation.[19]

Herbert Simon divides decision-making into three principal processes: (1) searching the environment for conditions requiring a decision--"intelligence activity"; (2) developing and analyzing possible courses of action--"design activity"; and (3) selecting a course of action from among feasible alternatives--"choice activity."[20] Simon has done a great amount of research attempting to improve human decision processes and to automate them, and contends:

> However significant the techniques for programmed decision making that have emerged over the last decade, and however great the progress in reducing to sophisticated programs some areas that had previously been unprogrammed, these developments still have untouched a major part of managerial decision making activity. Many, perhaps most, of the problems that have to be

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[18] Gallagher, 11-13.

[19] M.G. Weiner, "Observations on the Growth of Information-Processing Centers" (Unpublished paper prepared by Rand Corporation, Santa Monica, California, 1954), p. 1.

[20] Herbert A. Simon, The New Science of Management Decision (New York: Harper and Rowe, 1960), p. 6.

> handled at middle and high levels in management have not been made amenable to mathematical treatment, and probably never will.[21]

Jay Forrester also rebuts the implication of automatic management and elimination of middle management:

> A better understanding of decision-making and its information feedback context will not reduce the leadership demands on the executive. Quite the reverse. He will now have new methods to use and a new theoretical underlying structure to understand...The more skilfully these tools are selected and the more significant the goals, the more effective will be the application. New advances in physics have not led to automatic engineering.[22]

Donald R. Shaul, in a doctoral dissertation, rejects the thesis that electronic data processing will significantly change the nature and scope of the middle management function or the decision-making authority or status of middle managers. Shaul's premise is based upon numerous questionaires and "depth interviews" conducted throughout industry.[23]

The big problem facing organizations today is to develop an effective means of transmitting specialized functional knowledge and functional contributions to the overall objectives and profitability of the enterprise.[24] The

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[21] Ibid., 21.

[22] Jay W. Forrester, "Managerial Decision Making", Management and the Computer of the Future, ed. by Martin Greenberger (Combridge: MIT Press, 1962), p. 37.

[23] Donald R. Shaul, "The Effects of Data Processing on Middle Managers" (Unpublished PH.D. dissertation, Univ. of California, Los Angeles, 1964), pp. 183-188.

[24] Norman J. Ream, "The Organizational Relationships of Operations Research, Systems Planning, and Data Processing," The Changing Dimensions of Office Management (New York: American Management Association, 1960), p. 91.

electronic data processing systems, as over-all business control devices, without functional limitations, and the new analytical techniques---such as linear programming, queuing theory, communication theory, game theory, inventory optimization formulas, value theory, and others---are being used by managers to try to solve this problem. Mathematics, which has been applied to production and engineering problems for many years, is now also being applied to management control problems. The inability of clerical personnel to process copious amounts of information within the time constraints imposed by the nature of the problem has limited management's ability to weigh the effects of alternate decisions in the past.[25]

A dynamic analysis of the whole organizational structure to determine the decision-making interrelationships and information requirements of its diverse components is required preparatory to the development of an integrated management information structure. The functional knowledge and functional contributions of the various management levels must be integrated and channeled according to their individual responsibility to the organization. This can only be accomplished by means of effective management intelligence produced by an integrated management information system.

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[25] Theodore A. Smith, "From Burden to Opportunity: The Revolution in Data Processing," The Changing Dimensions of Office Management (New York: American Management Association, 1960), p. 27.

This system must embody decision criteria which will lead in all parts of the organization structure to decisions which are the most profitable or desirable for the enterprise as a whole.[26]

The impact of an information system on the formal organizational structure of an enterprise is considerable. The effectiveness and efficiency of the work flow in an organization are dependent upon the proper establishment of the decision rules and the information supplied to the rules. The degree of decentralization within a corporation is determined by the latitude that a given manager or department is permitted to interpret the actual content of the decision rules.[27] It is easy to see that the requirement of information for planning, operating, and controlling; the requirement for stratifying this information by functions, people, products, and geographical location; and the requirement to match the information to the organization structure are indeed going to cause changes in the organizational structure when first implemented.[28]

It should be pointed out that the actual flow of information, as differentiated from the production or use

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[26] Ream, The Organizational Relationships..., 92.

[27] E.A. Nelson, "A Charting Technique For the Analysis of Business Systems" (Unpublished paper prepared by Rand Corporation, Santa Monica, California, 1965), p. 7.

[28] William B. Bunker, "Top Management's Information Needs" Lecture to Wharton School of Finance and Commerce, April, 1963, quoted in McDonough, p. vii.

of information, does not have any organizational dependence. Therefore, the flow of data could be managed by a service function, such as a computer department, management services department, etc, without disrupting the chain of command.[29] If the management information system is properly constructed, and each functional element is considered in relation to the requirements of all, changes in one functional area can be reflected and measured in the others; this is a valid reason why the company-wide data processing unit should not be organizationally located under the control of one narrow functional group.[30] Westinghouse, General Foods, and Sperry Rand are a few companies that have shown data processing can be centralized without interfering with decentralized management.

Despite the many advances in data processing, the preparation of managerial planning and control reports and their proper utilization is too frequently unsatisfactory. The main reason for this breakdown is that the systems planners, who design the programs, and the managers, who operate the systems, often are unaware of the continuing reports on the total operations of the company.[31]

The success of any management information system depends on the establishment of criteria that specify distinctly

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[29] Nelson, 8.
[30] Gallagher, 77.
[31] *Ibid.*, 12-13.

the process of developing feed-back. The development of measures and standards by management which will serve as bench marks for comparisons is a difficult task. These criteria can vary from standards that require weighting by sound intuition and judgment to those based upon explicit quantitative methods and tests. They can be expressed in generalities or they can be very specific. The most explicit standards are expressed on a numerical scale and this is why increased emphasis is being placed on quantitative methods in management.[32] It is the intent of the feedback process to hold the standards fixed and to consider the performance as the variable.[33] Measures and standards developed for management purposes are equally as important to the future of information processing as those dealing with technical matters; although the emphasis up to the present has been concentrated on the latter.[34]

The summary diagram on the following page is a flow chart showing a typical management system. The feedback and evaluation stage is illustrated denoting its importance in the replanning or recycling process.[35]

Information Production Process

Information is useful intelligence only when there

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[32] McDonough, 184-187.
[33] Weinwurm, 27.
[34] *Ibid.*, 30.
[35] McDonough, 203.

the presence of [illegible]. The [illegible] of [illegible] [illegible] [illegible] [illegible] such as [illegible] [illegible] the [illegible] of a [illegible] [illegible]. [illegible] [illegible] [illegible] [illegible] by [illegible] [illegible] [illegible] [illegible]. [illegible] is [illegible] [illegible] [illegible] [illegible] standards are [illegible] [illegible] and increased requests in [illegible] [illegible] in conference.[34] It is the [illegible] [illegible] to make the standards [illegible] [illegible] of the variable.[35] [illegible] [illegible] of information [illegible] [illegible], although the [illegible] [illegible] communicated to the [illegible].[36]

The primary element in the [illegible] [illegible] a typical [illegible] [illegible]. [illegible] and [illegible] [illegible] in the [illegible] as [illegible] [illegible].[37]

INFORMATION [illegible]

Information is [illegible] [illegible]

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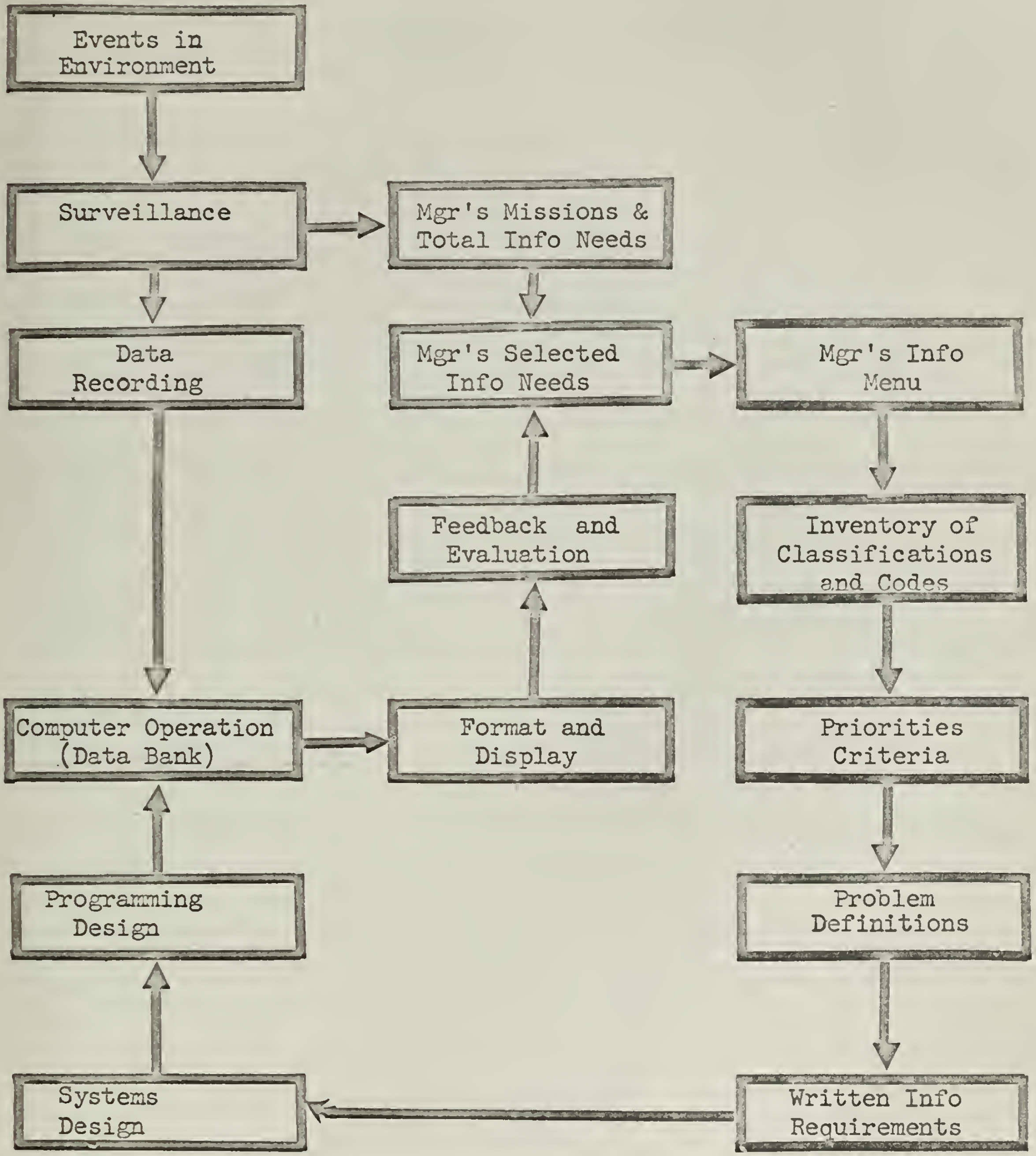
[34] [illegible], 106.
[35] Ibid., 17.
[36] Ibid., 36.
[37] [illegible], 181.

TABLE I

SUMMARY DIAGRAM FOR MANAGEMENT SYSTEMS



Source: Adrian M. McDonough and Leonard J. Garrett, Management Systems: Working Concepts and Practices (Homewood, Ill.: Richard D. Irwin, Inc., 1965). P. 203.

is a recognized need to know and when minimum volume and maximum relavance have been achieved. The truly useful information must be separated from the interesting. The information production process recognizes and facilitates the contribution of both managers and systems to the organization. The operating manager must actively contribute to the design of the information system to assure the derivation of information most useful and meaningful for his needs.

The overall information process includes the accumulation, transfer, use and storage of information. The key to the ultimate effective use of information starts with the determination of the information needs at the various levels of organization. The various levels of the management hierarchy have different information requirements. The lower echelons place greater reliance on detailed operating reports while higher echelons depend more on quantitative evaluation.

Until recently, information systems were commonly considered to comprise only monetary data; however, information is now viewed as including both nonmonetary data and nonquantitative information. It is also customary to insert principles and techniques such as auditing, internal checking, internal auditing and internal control into the system to insure the accuracy of the information.[36]

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[36] Robert N. Anthony, Planning and Control Systems (Boston: Harvard University, 1965), pp. 97-98.

It is obvious that managers can require an infinite variety of information and this fact should be recognized in the systems design; however, it should also be recognized that no system can ever have all the answers and anticipate all the possible requirements.[37] E. A. Nelson of Rand Corporation defines information as:

> ...that specific set of data required to arrive at a decision in accordance with the rules established. In a very real sense, the decision rules provide the "demand" for, and establish the character of, the information required; this is analogous to the way in which events in the work flow determine the need for decision rules. In a similar way, the performance of a decision rule may generate data. This data is information if it is required in turn by another decision.[38]

If an organization changes its information system frequently it is very difficult to know what information is available, what its application is to the various decision rules, and what the format of the management report will be. The management report of the future will consist of a "highly condensed exeeption-type presentation." "Voluminous printed reports depicting the fact that things are fine or that anticipated deviations from the norm have occurred will become a remnant of the dim dark past..."[39]

Systems Design and Operation

A comprehensive, quantified analysis of data-flows

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[37] McDonough, 110.

[38] Nelson, 6.

[39] John A. Postley, Computers and People (New York: McGraw-Hill Book Co., 1960), p. 73.

throughout an organization is necessary preparatory to designing the information system.[40] The conceptual problems that appear during this analysis must be reduced to as concrete a representation as possible so that a practicable system can be designed.[41] Warren E. Alberts, Vice President of United Air Lines, emphasizes this point:

> No matter how theoretical or revolutionary a system concept may be, it still must be constructed and understood by a human designer and fit the human organization it is to serve. This is independent of whether a final analysis shows the ultimate application to be manual, non-machine, or completely computerized.[42]

The interrelationships between functional tasks (work flows), organization structure, decision rules, information flow, and data processing must be accurately determined. The functional arrangement of data, documents, activities and overall operations into a logical order must be accomplished without regard to organizational assignments. Systems design is the creative work combining data processing equipment and techniques with the above interrelationships to form a network facilitating company-wide performance.[43] The successful achievement of effective and interrelated structures in organizations and systems is worthy of pursuit by all conscientious managers.

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[40] Robert H. Gregory and Richard L. Van Horn, Automatic Data-Processing Systems (Belmont, California: Wadsworth Publishing Co., 1963), p. 181.

[41] Gallagher, 115-117.

[42] Warren E. Alberts, "Proper Perspectives in Developing Management Controls," Management Control Systems, eds. Donald G. Malcolm, Alan J. Rowe, and Lorimer F. McConnell (New York: John Wiley and Sons, Inc., 1960), p. 19.

[43] Gallagher, 115-117.

The concepts of a management information system are related to the traditional concepts of organization as follows:[44]

Management Information System	Organization
Problem Definition	Planning
Systems Design	Organizing
Programming	Assembling Resources
Operating	Directing
Feedback and Evaluation	Controlling

The organization concept approach to systems deals with the design of the organization structure, and then the application of the communications needed for this structure. In contrast, the systems concept approach designs the communication structure and then conceives the organization needed to complement it. The organization approach stresses chains of command, authority, and responsibility while the systems approach stresses channels of communication, information flow, and decisions. The organization approach provides compartments of authority and responsibility, whereas the systems approach provides networks between question and answer points.[45]

The designing of a management information system presupposes that top management and all key executives in functional areas are cooperative and actively participating in its development. The data processing department personnel

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[44] McDonough, 10-13.
[45] Ibid., 14-17.

must be working closely with systems personnel and representatives of the functional areas if development is to proceed in a planned and organized manner. Sound financial planning must be displayed if the procurement of a data processing installation is to show an adequate return on investment.

J. D. Gallagher says the design of an effective management information system involves three basic elements:

> 1...use of data processing equipment involving computers and electronic input-and output devices for the rapid collection, manipulation, and tabulation of data.
> 2...use of highly developed communication links between electronic computers and input-output devices so that one machine can talk to another, or actually operate another, within the system.
> 3...proper selection and arrangement of information for planning and control so as to form a system of reports which will give each manager the key facts he needs for decisions underscoring especially the exception or abnormal situations needing his attention.[46]

It was pointed out previously that it is impossible to design a management information system that is applicable to all organizations because of the variability of certain financial and non-financial variables, representing components of the return-on-investment equation, that are relatively invariable in most production-and-sales businesses.[47]

The significance of each of these variables---sales volume, product mix, price, costs, and capital investment---will differ somewhat from one industry to another dependent

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[46] Gallagher, 11.
[47] Neuschel, 210.

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[47] Neuschel, 210.

upon changes in the economy, in the structure and objectives of the industry and in the organizational structure and objectives of the enterprise. The development of the information system relating to the financial variables, therefore, must be based on the characteristics of the industry and also reflect the relative importance of each variable in terms of its management use for planning and control.[48]

It is the responsibility of the system analyst to determine the relative importance of each of the variables in a system, the level at which each variable is influenced or controlled by management and the degree to which each variable should be measured.[49] This can not be accomplished effectively without the complete support and cooperation of management at all levels. Researchers of the Institute for Defense Analysis, in a study of computer applications in military command and control, reported that command personnel must be intimately involved in design and development of their computer aided command information processing system and cannot successfully delegate this responsibility.[50]

No amount of complex and speedy manipulation of these system variables by electronic computers can substitute for a

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[48] Gallagher, 64-65.

[49] Ibid.

[50] "Where the Computer Fits in Command and Control," Armed Forces Management, 8 (July, 1962), p. 23.

carefully conceived system. Arthur L. Samuel says:

> A digital computer is, after all, only an inanimate assemblage of mechanical and electrical parts that functions in a completely mechanistic fashion... Nothing comes out of the computer which has not been put into it... and the computer can only do what we know how to instruct it to do...The answers which the computer is called upon to produce are all derived from the input data by the application of a strict set of rules that are known and that have been written down in advance...[51]

Management is held accountable for its actions in the conduct of business. This basic business precept demands that the management information system design be flexible to enable the managers to cope with changing situations.

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[51] Arthur L. Samuel, "Artificial Intelligence Progress and Problems," Computers and Automation, XII (March 1963), pp. 29-30.

CHAPTER II

MANAGEMENT RESPONSIBILITY

Management Performance

How is management performing in this age of rapid technological change? Dr. R. L. Martino, head of Olin Mathieson Chemical Corporation's Advanced Systems Department, has pointed out that we are only beginning to harness modern computers and the systems engineering approach to control the business environment. In an address in 1965, he said, "A new brand of managers is urgently needed... Most company managements are out-moded and no longer adequate to direct the complex structures of their companies."[1]

Edmund Dwyer of the General Services Administration states that there are only four fundamental ways an organization can improve the performance of its managers:

> 1. By enhancing the motivational environment.
> 2. By improving managerial skills through education and training.
> 3. By apportioning managerial responsibility, through proper organizational planning, in such a way as to make the most effective use of existing skills.
> 4. By improving the basis of all management action: The management information system.[2]

The first three ways involve the human element, whereas

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[1] R.L. Martino, an address delivered to Systems Engineering Exposition and Conference held in New York on June 8-11, 1965.

[2] Edmund D. Dwyer, "Improving the Management of Data-Processing Operations," The Changing Dimensions of Office Management (New York: American Management Association, 1960), p. 59.

the fourth way relies on the improvement of a system. The improvement of this system, however, can only be affected by the improved performance of the managers and data processing people responsible for the systems development.

Schultz and Whisler assert that with systems development, the management process becomes more explicit with the manager utilizing the new technology in his planning and decision and information processing functions. They are quick to point out, however, that he is thus more readily exposed to examination, and the continuing pressures on him are wide open for scrutiny.

> If the manager must make more decisions, more explicitly, he must also learn to use the new tools at his disposal effectively. We are not suggesting, of course, that he must be a universal technician, but he must understand the nature of the tools and of the intellectualized research processes associated with their use. It seems likely, then, that information technology will increase the demands on the intellectual capacity and range of managers.[3]

Peter Drucker describes the high performance manager needed for today and tomorrow as:

> ...Not an engineer looking upon human beings with the analogy of a well designed mechanical implement in mind, but a "Systems thinker" looking upon human beings in a group as living, organic, moving parts of a whole, where the whole has to be effective and where effectiveness above all considers doing things that are really important instead of frittering away time and energy in doing things, no matter how "efficiently", that are not primarily contributing to performance results.[4]

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[3] Schultz and Whisler, 17-18.

[4] Peter F. Drucker, "Fifty Years of Management-A Look Back and a Look Forward," <u>Fifty Years of Progress in Management</u> (New York: American Society of Mechanical Engineers, 1960), pp. 114-117.

The main role of the manager must be performance. William T. Ingram, Vice President of Reynolds Metals Company, contends that the manager knows how to make things happen through the efforts of other people and by utilizing the resources at hand. He avows that the functions of the manager are to define and analyze problems, to make decisions, and to convert decisions into effective action. "He does this by motivating, guiding, and organizing people."[5]

The excesses of technological advancement must not be permitted to obscure the managerial role of performance. Dearden believes that unnecessary restraints on the manager from over-centralization could have deleterious effects on his performance.

> Our new ability to produce measuring information will make possible effective self-control; and, if so used, it will lead to a tremendous advance in effectiveness and performance of management. But if this new ability is abused to impose control on managers from above, the new technology will inflict incalculable harm...[6]

In assessing the performance of an executive, Crawford Greenewalt of E. I. DuPont de Nemours had this rather interesting observation to make:

> ...The more effective an executive, the more his own identity and personality blend into the background of his organization. The more able the man, the less he stands out, the greater his relative anonymity outside his own immediate circle.[7]

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[5] William T. Ingram, "The Role of the Manager in Industry," Vital Speeches, XXXI (November 15, 1964), 94-95.

[6] Dearden, 133.

[7] Crawford H. Greenewalt, The Uncommon Man (New York: McGraw-Hill Book Co., Inc., 1959), p. 66.

Greenewalt's remarks become more profound when one considers the movement toward management by exception. An effective executive whose performance did not stray from the standard or norm would be less likely to come under the scrutiny of his boss.

Criteria for Information Requirements

There are infinite numbers of ways to classify criteria for management information requirements. One can expect these criteria to vary with the industry, the environment, the management, the objectives of the organization, ad infinitum. So what is the importance of concentrating on the seemingly impossible task of developing meaningful criteria for processing information? Harvey Protzel has reported results of research indicating that faulty information processing was a contributing factor in ninety percent of business collapses; and that paper work is the single largest maintenance cost of a company regardless of its size.[8]

Generally accepted and applicable standards on which a manager may rely in making decisions are practically nonexistent at the present time. G. F. Weinwurm says, "While decisions are made every day, they are too often based on an ad hoc blend of experience and intuition, sleight-of-mind, and temerity."[9] He also believes that "the absence of well-defined and generally accepted relations between theory and practice is...quite

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[8] Harvery W. Protzel, "What Top Management Should Expect From an Integrated Data Processing System," Computers and Automation, XIII (September, 1964), p. 12.

[9] Weinwurm, 4-5.

probably the greatest present obstacle to the development of managerial standards and techniques in the field of ADP." He contends that tasks must be identified and distinguished with reasonable accuracy before economic measurement can be made.[10]

Weinwurm does not profess this to be an easy task nor does he see resolution of this mighty problem in the near future.

> If history is any guide; we cannot expect that the resolution of the diverse strands of information processing terminology with theory and practice will take place in the near future. On the contrary, the process of definition and unification promises to be long and arduous. In the case of economics, the distillation of even a small and gross set of generally accepted axioms and classification took at least a century and a half, and perhaps more, depending on one's point of view; with respect to management, the problem of terminology has been under active consideration for at least fifty years, and seems far from settled.
>
> But if information processing is ever to stand apart as a scientific discipline in its own right, if the doubters are to be dissuaded who contend that all the computer-related arts are nothing more than applications and extensions of existing knowledge, and if computers are to reach their full potential in science and industry, then systematic research in the management of automatic data processing must be pursued with a great deal more enthusiasm and stamina than has been the case in the past. I do not intend to suggest that, without management research, automatic data processing is in danger of decline. The need for the computer's special contributions is far too great...[11]

Paul Snider has declared that a major requirement for top management today is concentrated information which concerns itself with all the factors in the business and industry which influence the decision-making process. He revealed in a survey and study that most of the vital information is available from

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[10] Ibid.

[11] Ibid., 8.

sources within the business or from business associates.[12]

In polls conducted during American Management Association Presidents' Round Table sessions the "...presidents emphasized that they are not getting all the information they need, are not getting information fast enough, are not getting information in clear, concise form." The polls further revealed that the presidents complained that they were not able to deal satisfactorily with the "tidal wave of information which new knowledge and easy communication have produced." The consensus also was that "their efforts...have been centered on 'digging through the information junk pile' when they need specific knowledge bearing on specific decisions which they must make;...they dig to keep informed."[13]

Adrian McDonough enumerates five important keys to an effective management information system:

1. Surveillance - "refers to all those activities by which a better perspective on an organization and its environment is obtained."

2. Criteria - "measures of performance."

3. Classification - "very beginning of the organization of facts and information. (It) is a grouping of items of similar characteristics into classes or sets."

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[12] Paul Snider, Information Control for Top-Level Decision Making, Presidents' Professional Association Special Study No. 5 (Hamilton, New York: Presidents' Professional Association, Inc., 1962), pp. 1-3.

[13] Ibid.

4. Documentation - "recorded set of evidence showing the characteristics of some part, or all, of a management system." An organization must keep track of what is in its existing system if it is ever to make a comparison between existing and proposed systems.

5. Boundaries - "as we try to increase a system's scope or take on larger problems, there are compounding complications that set up restraints."[14]

The major task confronting management today is to tie systems content to job content and this can only be accomplished if the system and job are thoroughly understood by those designing the system.

At opposite extremes, inadequacy and duplication are widespread in present systems. Adrian McDonough claims that there must be a concentration on being specific about what is wanted from a system and on getting the real measures of performance expected. He says, "Identification of criteria associated with various organization levels can provide a relatively crisp structure of an organization's decision needs."[15] By concentrating on criteria one can approximate the values that should be provided by an effective management information system. "Criteria statements are logical extensions of initial problem definitions.

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[14] Adrian M. McDonough, "Keys to a Management Information System in Your Company," The Third Generation Computer (New York: American Management Association, 1966), pp. 25-33.

[15] Ibid.

They provide at least preliminary bench marks for testing the success of a project," he also says.[16]

McDonough concluded from numerous interviews with top executives of industry that their primary concerns could be categorized into seven broad management activities:

1. Setting the company's short and long term objectives..
2. Determining the company's overall policies.
3. Making or approving decisions that have significant impact on the company's future profits or operations with particular emphasis on promoting innovation.
4. Coordinating several major corporate functions.
5. Developing and maintaining an organization of qualified subordinates.
6. Delegating responsibilities and authority to the organization.
7. Controlling performance and results through at least one level of supervision.

Almost every executive with whom he spoke cited achievement of the company's overall objectives as his prime objective. Planning and setting the company's policies and objectives ran a close second in the consensus.[17]

Dr. Robert N. Anthony divides the management activities among the customary management functions of strategic planning, management control, and operational control. These are listed on the next page. The business activities classified under strategic planning are almost entirely planning activities and, consequently, carried out by top management almost exclusively. Those activities classified under management control are a

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[16] _Ibid._
[17] _Ibid._

TABLE 2

MANAGEMENT ACTIVITIES

Strategic Planning	Management Control	Operational Control
Choosing company objectives	Formulating budgets	
Planning the organization	Planning staff levels	Controlling hiring
Setting personnel policies	Formulating personnel practices	Implementing policies
Setting financial policies	Working capital planning	Controlling credit extension
Setting marketing policies	Formulating advertising programs	Controlling placement of advertisements
Setting research policies	Deciding on research projects	
Choosing new product lines	Choosing product improvements	
Acquiring a new division	Deciding on plant rearrangement	Scheduling production
Deciding on non-routine capital expenditures	Deciding on routine capital expenditures	
	Formulating decision rules for operational control	Controlling inventory
	Measuring, appraising, and improving management performance	Measuring, appraising, and improving workers efficiency

Source: Robert N. Anthony, Planning and Control Systems (Boston: Harvard University, 1965), p. 19.

mixture of both planning and control, while those classified under operational control are almost completely control functions and carried out by the lowest members of the management hierarchy.[18]

Snider states that the development of control information (and, consequently, the range of control decisions) is dependent on the interrelationship of (1) company objectives, (2) strength of competition, (3) president's relationship to the board, (4) extent to which management is decentralized, (5) degree of trust president has placed in subordinates, and (6) president's own personality.[19] External information or reports also have a significant influence on the decision process when coupled with information developed within the organization. Some of the more important intelligences which would have a bearing on business decisions are as follows:

1. Significant business indicators.
2. Significant new thoughts or ways of viewing existing knowledge which affect the industry.
3. Short-range and long-range forecasts of competitive developments outside the industry.
4. New laws, regulations, etc. affecting industry (including sentiments).
5. Specific political information affecting industry.
6. Broad changes in consumer habits, demands, thinking.
7. New scientific discoveries.
8. Research now going on or planned.
9. Activities in labor groups.
10. New service industries, new services available, new service demands.
11. Competitive developments in peripheral industries.
12. Significant shifts in attitudes, trends in attitude formation.

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[18] Anthony, 15-21.

[19] Snider, 8.

13. Trends in education, particularly in higher education-relating to business world.
14. Military contracting activities.
15. New sources of capital trends in finance.
16. Impact of new developments in space on the industry.[20]

Anthony describes strategic planning, management control, and operational control as internally oriented; that is, they are concerned with activities that occur inside an organization. He further states that financial accounting is externally oriented since it "is the process of reporting financial information about the organization to the outside world."[21] This comparison could be further amplified by adding that the first three processes are accomplished internally but with heavy reliance on the receipt of external information, whereas the financial accounting process is externally oriented but almost entirely dependent upon information generated internally.

It was mentioned earlier that there are an infinite number of ways to classify criteria for management information requirements. McDonough has enumerated the criteria for a production-and-sales organization which are critical in the evaluation of management performance. These key-result areas are starting points from which detailed information needs may be developed.

1. Profitability Criteria
2. Market Position Criteria

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[20] *Ibid.*, 16.
[21] Anthony, 21-22.

3. Productivity Criteria
4. Product Leadership Criteria
5. Personnel Development Criteria
6. Employee Attitudes Criteria
7. Public Responsibility Criteria
8. General Criteria (not limited to any particular key result areas)[22]

Within the first key-result areas, profitability, there are numerous examples of sub-criteria which could be listed such as break-even point, return on investment, return on sales, salable market potential, total industry sales, cost of production, and company profits. These categories can be broken down further, e.g., cost of production includes raw materials, purchased parts, machine tools, salaries, etc. It is apparent that the volume of information available is tremendous and worthy of the best efforts of management to make their needs as explicit as possible, but also as moderate as possible.

The key-result area criteria and all their subgroups or subclasses can be further classified by information content---dollars, items (goods or services), facilities, locations, people, and programs. The information content can be given further identification by name of the class, units of measure, forms of information presentation, time dimension, and quantifiers related to identifier elements. For example, a need-to-know about completed SST jet engines could be required under several key-result areas, but it can be assumed that it is needed under

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[22] Adrian M. McDonough, Information Economics and Management Systems (New York: McGraw-Hill Book Co., 1963) pp. 192-194.

productivity and under this category in finished goods inventory. It could be classified thus:[23]

Productivity Criteria

Finished Goods Inventory

Name of class	SST Jet Engine	
Units of Measure	Assembly	
Forms of Information Presentation	Count and %	
Time	1 May Last Year 1 May This Year	
Quantifier	100 150	50% Increase

Herman Limberg, Senior Management Consultant of the Office of the Major, City of New York, gives the following succinct criteria upon which the information requirements of an effective management reporting system should be predicated:

1. Simplicity in the compilation, presentation and reporting of data to insure a minimum of effort in preparation, analysis, interpretation, and evaluation.
2. Comprehensiveness and adequacy for appraisal and decision making.
3. Timeliness.
4. Reliability.
5. Significance in the light of predetermined objectives.[24]

Insofar as these characteristics are built into the system, the value of the analyses will be correspondingly raised.

It is apparent that the establishment of criteria and

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[23] McDonough, <u>Management Systems</u>..., 96-103.

[24] Herman Limberg, "The Management Reporting System of the City of New York," <u>The Changing Dimensions of Office Management</u> (New York: American Management Association, 1960), p. 104-106.

identification of information present a formidable challenge to the management of any organization. This formal approach to the resolvement of management problems should not be attempted if the state of an information system does not guarantee, at least minimally, that the analysis will be more effective than experienced intuition. The primary goal must be to develop systems which will provide selected information with which the manager can make decisions and accomplish his job.

Manager of the Future

The manager of the future will be an executive of broad knowledge and appreciation of the total picture in his organization and in the industry in which his organization is competing for markets. This executive will make decisions utilizing the instantaneous availability of accurate information, the analysis of situations by computers and knowledge of the consequences of one alternative compared to other courses of action. As Garrett says, "In the electronic age specialization will be an embarrassment to anyone with managerial aspirations."[25]

Melvin Anshen points out the problem of specialization as a "critical danger." Those organizations whose managers have ignored the advanced techniques of analysis and familiarization with the capabilities and limitations of the computer invite a

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[25] Garrett, 45.

serious risk of sabotaging management. This managerial abdication frequently leads to excessive investment in computer hardware, ineffective system design and implementation, and a stymieing of the creativity of managers, which should, in reality, be upgraded.[26]

Leavitt and Whisler contend that information technology of the future will have its greatest impact on middle and top management:

> 1. Information technology should move the boundary between planning and performance upward. Just as planning was taken from the hourly worker and given to the industrial engineer, we now expect it to be taken from a number of middle managers and given to as yet largely nonexistent specialists: "operations researchers," perhaps, or "organizational analysts." Jobs at today's middle-management level will become highly structured. Much more of the work will be programed, i.e., covered by sets of operating rules governing the day-to-day decisions that are made.
>
> 2. Correlatively, we predict that large industrial organizations will recentralize, that top managers will take on an even larger proportion of the innovating, planning, and other "creative" functions than they have now.
>
> 3. A radical reorganization of middle-management levels should occur, with certain classes of middle-management jobs moving downward in status and compensation (because they will require less autonomy and skill), while other classes move upward into the top-management group.
>
> 4. We suggest, too, that the line separating the top from the middle of the organization will be drawn more clearly and impenetrably than ever, much like the line drawn in the last few decades between hourly workers and first-line supervisors.[27]

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[26] Melvin Anshen, "Managerial Decisions," *Automation and Technological Change*, ed. by John T. Dunlop (Englewood Cliffs, N.J.: Prentice-Hall Inc., 1962), p. 81.

[27] Harold J. Leavitt and Thomas L. Whisler, "Management in the 1980's," *Harvard Business Review*, 36 (November-December, 1958), 41-42.

Harold F. Smiddy, Vice President of General Electric Company, takes exception to Leavitt and Whisler's contention that future decision-making in business organizations will become increasingly centralized and that the work of people who are now in middle management will be increasingly "programmed" from such centralized points. Smiddy maintains that "information-system principles...employing the most advanced concepts of information technology, can be used to avoid centralized planning and decision-making, and can...be used to get the planning and deciding done directly at the work-place to an ever-increasing degree." This will be all the more true as businesses become more complex, diversified, and geographically deployed.[28]

In order to take full advantage of computer technology and systems development, the manager of the future will have to show patience and a belief in their long-term advantages rather than use them in a quest for the immediate returns that characterize trivial data processing projects. The successful manager will be one who is not only capable of using the computer's services but also of contributing to the advancement and improvement of its services.

From where will the manager of the future emerge? Edward Shils says that the development of a highly skilled manager is causing serious problems in this time of rapid technological change.

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[28] Harold F. Smiddy, "Research-And Shaping the Future of Management," Current Issues and Emerging Concepts in Management, ed. Paul M. Dauten, Jr. (Boston: Houghton Mifflin Co., 1962), 317-318.

> I will not be surprised if we have to wait for a whole new generation of managers before we put automation into full effect. I suspect it will take that long to develop the new perspective. Even then the universities will be able to complete the evolution in time only if they modernize their mathematics courses...and add computer laboratories where physical and social sciences can be studied as the intertwined realities they are...[29]

Garrett has this to say about the education of future managers in information disciplines:

> The newly emerging planning functions call for versatile, skillful, highly trained information specialists and planning executives. The International Business Machines Corporation has initiated a professional systems institute, at graduate school level, which is attempting to piece together an organized discipline for education in information. Industry as a whole has not yet squarely faced the problem. Universities are more keenly aware of their responsibilities to prepare for the radical changes that will occur in professional standards. A number of special courses have been created in computer and information technology at undergraduate and graduate levels. It is essential, however, for the implications of the new technology to be given greater attention in finance, production, marketing, and industrial engineering courses.[30]

Mr. George F. James of the Socony Mobil Oil Company concurs with Garrett:

> It is my belief we have passed the point where progress is dependent chiefly on advances in hardware systems, and that the future rate of progress in the systems and data processing field will be directly dependent on the ability of industry and our educational systems to develop and train people who can give direction to systems programs in complex industrial and governmental environments.[31]

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[29] Edward B. Shils, Automation and Industrial Relations, (New York: Holt, Rinehart and Winston, 1963), p. 90.

[30] Garrett, 50.

[31] George F. James, quoted from an address to the American Management Association Electronic Data Processing Seminar, 1963, AMA Conference Reporter, (New York: American Management Association, 1963), pp. 1-2.

Professor Joseph W. Towle of Washington University suggests that the Master of Business Administration degree should be the minimum prerequisite for entering the profession of management henceforth.[32]

Peter Drucker contends that managers of the future must be more actively engaged in using ideas to shape the economy, markets, and operations of the future.

> The ideas on which tomorrow's business is to be built *must* be uncertain; no one can really say as yet what they will look like if and when they become reality. They must be risky; they have a probability of success, of course, but also a probability of failure. If they are not both uncertain and risky, they are simply not practical ideas for the future.[33]

The consensus of opinion appears to indicate that the successful manager of the future will be creative, very knowledgable about his organization and industry, highly trained in computer technology and systems development, and yet he will not be a specialist. The manager of the future will have tremendous demands placed upon his intellectual capacity and range. "In the final analysis our manager shortage may indeed be much more serious than our engineering and scientific shortage."[34]

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[32] Joseph W. Towle, "The Challenge that Management Is a Profession," Dauten, 323.

[33] Peter F. Drucker, "The Big Power of Little Ideas," *Harvard Business Review*, 42 (May-June, 1964), 12.

[34] Keith Davis, "Management Brain-Power Needs for the 1970's," Dauten, 300.

CHAPTER III

THE REVOLVING FUND

Background and Description

A revolving fund is a fund established, pursuant to authority of specific provisions of law, to finance a continuing cycle of operations. The receipts derived from such operations are available in their entirety for use by the fund without further action by Congress. The only limitations are those established through the budgeting and apportionment procedures and subject to laws and regulations governing certain miscellaneous types of receipts, e.g., loan funds, management funds, stock funds, and industrial funds.[1]

There are 121 revolving funds in the United States Government. These consist of 80 public enterprise funds, 30 intra-governmental revolving funds, and 11 trust revolving funds. Each government-owned corporation has a revolving fund organization structure; in addition, many unincorporated enterprises within the government have such funds.[2]

Revolving funds used in the government for the segregation of activities which involve transactions with the private sector

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[1] U.S. Department of the Air Force, Glossary of Terms Used in Air Force Comptroller Activities, September, 1955, p. 46.

[2] U.S. Bureau of the Budget, Report on Proposals For New Revolving Funds, June, 1960, p. 3.

are called public enterprise funds. Those revolving funds whose receipts are derived solely from inside government are called intra-governmental funds. Trust funds are those revolving funds in which a department or agency acts as a trustee over funds which it does not own.[3] Some of the leading characteristics of revolving funds are described as follows: (1) The fund is administered directly by an agency, department, or corporation; (2) The initial capital is provided by an appropriation which is available for an indefinite period---at least for a longer period than an annual appropriation; (3) The revenue is derived for services or products rendered and is available for subsequent use without further action by Congress; and (4) The funds have a wide area of usefulness as an internal management device in business-type activities of the government.[4]

Revolving funds provide a financial segregation of activities that generate revenues thus facilitating budgeting at the agency or department level. These revenues are not included in general revenue, and fund expenditures are reported to the Treasury only to the extent of the excess of expenditure over revenue. Additional appropriations to cover the net expenditures of such funds are itemized separately within the appropriations for the department or agency.[5]

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[3] Jesse Burkhead, Governmental Budgeting (New York: John Wiley and Sons, Inc., 1965), pp. 265-267.

[4] Arthur Smithies, The Budgetary Process in the United States (New York: McGraw-Hill Book Co., Inc., 1955), p. 397.

[5] Burkhead, 265.

Revolving fund revenues are obtained by the sale of goods or services which are charged to the user or ordering agency. The funds are initially financed from an appropriation, but thereafter the fund is expected to be self-supporting with no further effect on budget expenditures. The initial appropriation is nonrecurring and the activity is thereafter omitted from budgetary statements. The only budgetary review is that offered by the General Accounting Office during its periodic audits and reports to Congress.[6]

Objectives

The major objective of the federal government in establishing revolving funds is to control and account for the cost of specific programs and work performed in the government. For example, the stock funds were established to achieve a more effective management of inventories of consumable material and greater economy in utilization of such material through budgetary and fund control of expenses of the customers which use them. That effective supply management has been achieved is evidenced by the return of nearly $5 billion of excess cash balances to the Treasury. This is tangible evidence of the merits of controlling the consumable material inventory program by means of a revolving fund.[7]

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[6] Ibid., 267.

[7] U.S. Congress, Senate, Committee on Armed Services, Report on the Operation of Stock Funds in the Military Establishment, 86th Cong., 2nd sess., 1960, S.R. 261, p. 19.

There are those advocates of revolving funds in the government who believe that efficient programs cannot be expected to be tied to annual appropriations. They claim that the uncertainty which results from an annual financing procedure prohibits a business-like operation. These people are the proponents of "backdoor spending"[8] within our society.[9]

Some government corporations were established with revolving funds with the explicit intention of obviating the restraints placed upon regular government departments by statute or by administrative regulations. It was felt that greater flexibility and better results could be achieved with more freedom of control. This independence of action from both the Congress and the General Accounting Office was restricted somewhat by the Government Corporation Act of 1945 which required corporations to submit certain budget data concerning their operations.[10]

In a large government the judicious utilization of resources requires that certain kinds of goods and services useful to a number of activities be supplied centrally as a common service. The Department of Defense has pioneered in this area with the establishment of the Defense Supply Agency and single

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[8] Backdoor spending is the provision of authority to spend money from the Treasury, or to incur obligations requiring future expenditure, in legislation which is not part of the appropriation. Vera Knox, Public Finance-Information Sources, (Detroit: Gale Research Co., 1964), p. 93.

[9] J.C. Jackson, "Backdoor Finance of Federal Operation," The Library of Congress Legislative Reference Service, (Washington: U.S. Government Printing Office, 1959), p. 13.

[10] *Ibid.*, 9.

manager stock funds. These give the manager single control for all military departments for certain designated categories of items as to procurement, supply, issue at wholesale level, and the other elements of supply management responsibility.[11]

President Eisenhower in the Budget Message of the President of January 18, 1960 summarized his reasons for the establishment of revolving fund organizations thus:

> Major business-type activities of the Government should, with few exceptions, operate on a self-sustaining basis. Their budgets and accounts should permit ready comparison of their expenses and revenues. They should have simplicity in their financing structure and the flexibility in expenditures necessary to meet unforseen business conditions, but should be expected to keep their obligations and expenditures within the resources provided by Congress for that purpose and should be subject to annual review and control by the Congress.[12]

Advantages and Disadvantages

The beneficial characteristics and advantages of revolving fund operations are numerous and worthy of enumeration in order to explain the funds wide acceptance in the federal government. A Bureau of the Budget report states them as:

> 1. (They) provide a clearer presentation of profit or loss, because it will automatically bring into close relationship the expenses and the revenues of the enterprise. Business-type budgeting and reporting, including balance sheets are automatic under a revolving fund arrangement. Congress can more readily determine the extent to which it wishes to draw upon general taxation to finance an enterprise. In contrast, the traditional method of appropriation financing tends to obscure rather than to disclose the significant facts about business enterprises.

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[11] Senate Committee on Armed Services, Report on the Operations of Stock Funds..., p. 18.

[12] Budget Message of the President of January 18, 1960, quoted in U.S. Bureau of the Budget, Report on Proposals for New Revolving Funds, June, 1960, p. 5.

among these funds. These give the maximum single control for all military departments for certain designated categories of items as to procurement, supply, issue at wholesale level, and the other elements of supply management responsibility.[11]

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Advantages and Disadvantages

The beneficial characteristics and advantages of revolving fund operations are numerous and worthy of examination in order to explain the funds wide acceptance in the Federal government. A digest of the Hoover report states them thus:

> 1. (They) provide a clearer presentation of costs by tying together all expenditures to the income related to the operation and the purposes of the enterprise. Expenses from budgeting and reporting, including balance sheets are available under a revolving fund arrangement. Congress can more readily determine the extent to which it wishes to rely upon general taxation to finance an enterprise. In contrast, the traditional method of appropriation financing tends to obscure income used to offset the significant portion of business activity.

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[11] Senate Committee on Armed Services, Report on the Operations of Stock Funds..., p. 13.

[12] Budget Message of the President of January 18, 1960, quoted in U.S., Bureau of the Budget, Report on Progress in Use of Revolving Funds, Nov. 1960, p. 3.

2. (They) will provide greater simplicity in the financing and funding structure. In lieu of many separate pockets for the deposit of receipts, a somewhat unbusinesslike arrangement, revolving fund legislation will generally permit the receipts of a single enterprise to be placed in one fund, which will be available, for the necessary expenses and capital outlay of the enterprise concerned. The present multiplicity of accounting pockets of receipts not only creates unnecessary work, but possibly contributes to difficulty in obtaining appropriate understanding of the total program and financial input involved.

3. Flexibility in operations will be improved, within such budget controls as Congress chooses to exercise from year to year. While each revolving fund must necessarily keep within the capital Congress provided for it, plus its receipts, it is customary for Congress to provide a somewhat higher degree of flexibility to meet unforseen conditions than is the case for appropriation. Therefore, if the volume of aircraft landings and take-offs should run above the number estimated when the budget is made up, it could be expected that the National Capital Airports could use the additional receipts involved in paying the additional expenses incident to the increased volume, without the necessity of spending several months seeking and obtaining a supplemental appropriation. Where the government offers to provide a major business-type service for a charge, such as the providing of power or the operation of an airport, the agencies concerned should be able to respond readily to increased customer demand.

4. (They) provide more incentive for effective management of revenue than if the receipts are placed in the General Fund of the Treasury. This is particularly true where the fund is designed to be self-sustaining, or nearly so.

5. The use of revolving funds removes possible distortion and inflation from the totals of budget receipts and expenditures. Revolving fund expenditures are stated on a net basis in the budget totals, reflecting over the long run charges which must be paid by the taxpayer. Without a revolving fund, the same activities are counted on a gross basis within the budget totals, even in those cases where their expenditures are matched by user charges in the budget receipt figures.[13]

The advantages of the stock funds which are used to finance procurement and inventories of consumable material are also numerous:

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[13] U.S. Bureau of the Budget, Report on Proposals for New Revolving Funds..., pp. 4-5.

1. Consolidates operating and fiscal responsibilities under one management.
2. Effects common use of inventories.
3. Reduces operating stocks to a minimum.
4. Enforces supply discipline through cost consciousness-incentives.
5. Protects mobilization stocks when they are issued for current consumption.
6. Accomplishes more orderly and timely procurement.
7. Curtails incentive for year-end buying sprees.
8. Provides funds automatically for replenishment of stocks through reimbursement from sales.
9. Affords flexibility and quick response to customers' requirements.
10. Assists in balancing inventories.
11. No interruption of obligating authority at year's end.
12. Economies realized through requirement to pay for the supplies versus old method of free issue.
13. Realizes a businesslike type of management.
14. Improves budgetary control of expenses of operating activities through funding for consumption of material.
15. Provides means whereby operating activities with program responsibility can assure obtaining needed materiel with available funds. They are not dependent on someone else.[14]

The Bureau of the Budget enumerated additional advantages of stock funds in a report prepared by its Military Division:

1. Should force standardization of procurement, storage, and issue policies thus facilitating inter-service utilization and balancing of stock.
2. Material needed or consumed by two or more appropriations can be carried in a single inventory, procured in a single operation, and be available on the shelf for issue to appropriations which have the funds in current budgets to pay for the material. This has the effect of reducing <u>overall</u> inventory and stock levels.
3. A stock fund facilitates procurement of commodities of a seasonal character at times when the market is most favorable.
4. Financial management is considerably strengthened by the stock fund, and supply management will be enhanced and made more responsive to efficiency and demands through the instrumentality of the stock fund.[15]

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[14] Senate Committee on Armed Services, <u>Report on Operation of Stock Funds...</u>, p. 19.

[15] U.S. Bureau of the Budget, <u>A Report on Stock Fund Management in the Department of Defense</u>, June, 1957, p. 14.

The statements of disadvantages which follow are allegations or beliefs of those who do not support the revolving fund concept. Their positions are presented to give an indication of the opposition faced by the revolving fund manager and the obstacles which must be overcome if the fund is to be effective.

1. The military forces risk to a greater degree the grounding of aircraft or nonavailability of equipment for lack of spare parts, if such materiel is financed by a stock fund. However, the degree of risk is proportionate to the quality of financial management, especially in coordination of programming, budgeting and funding, and with good management the risk should not be significant.
2. It is easier to get appropriated funds for procurement and production than for operation and maintenance. Hence spare parts should be procured under procurement-and-production appropriations and issued free.
3. The use of stock funds results in increased paperwork with greater administrative costs.
4. Apportionment control of procurement obligations under stock funds tends to destroy the advantages of the stock fund from the standpoint of improving supply management.
5. It is believed by some that financing "technical" materiel, such as aircraft spare parts, under a stock fund is a mistake because of stock obsolescence losses which are bound to occur. They believe such losses might impair the solvency of the stock fund unless covered by specific appropriations to restore capital, and that requests for such appropriations would be looked upon unkindly and perhaps refused.
6. If stock funds are used to finance concurrent procurement of spare parts, procurement contracts will require citations of two funds: (a) stock fund, and (b) procurement-and-production appropriated fund, for the major equipment. This results in complicated accounting requirements for both the procuring agency and the contractor under "indefinite price" contracts which are common in the area.
7. In case of all-out-war, the use of stock funds and consumer fund control would have to be abandoned completely. In case of limited war, the use of stock funds and consumer fund control would have to be abandoned in the combat area.[16]

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[16] Senate Committee on Armed Services, Report on Operation of Stock Funds..., pp. 29-31.

In weighing the advantages of revolving fund type organizations against their disadvantages, the preponderance of evidence seems to support their continued authorization. There will be evidence of waste and inefficiency in some organizations but the organization structure is basically sound and the establishment of adequate management control will alleviate such situations.

CHAPTER IV

MANAGEMENT OF A REVOLVING FUND

Present Situation

The author has not attempted to delve into the structures of all the different revolving fund organizations, but instead, has selected a hypothetical revolving fund organization for the development of a management information system. The organization that was chosen is hypothetical to the extent that its establishment has been authorized by Congress but the framework, plans and policies, and resources are still in the embryonic stage. Congress has not appropriated funds, as yet, for the operation of the fund.

The sustained growth in the number of computers in the federal government and the costs incurred as the computer moves into virtually every major field of government underline the need for the accumulation and reporting of appropriate data on the government's procurement, utilization, and working experience with ADP equipment. The billions of dollars that the government has invested represent expenditures for the development and use of computers and computer-related devices, communications facilities and physical plant facilities; site preparation, purchase, rental and maintenance of equipment; machine programs, data processing systems, procedures, and software; data recorded on magnetic tape or other data processing media and data banks; personnel,

management expertise, training, and travel; miscellaneous equipment, fixtures, supplies of magnetic tape, and other recording devices and media; contractual services for hardware, software, and automatic data processing related services; and other related items.[1]

The present federal government automatic data processing resources are the result of an eruption of numerous independent systems in the departments and agencies.[2] Responsible line managers in the government have greatly underestimated the impact of the computer on the management discipline and have failed to use effectively the tremendous potential of automatic data processing equipment. Effective management of automatic data processing equipment in the federal government has been severely hampered by the lack of essential information on a timely basis.

Experience in government and industry has demonstrated the urgent need for management to take over the reins of automatic data processing activities. With the growth of ADP, various organizations in the federal government have begun developing policies governing the management of automatic data processing in order to facilitate proper use of the equipment and to assist in resolving problem areas.

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[1] U.S. Comptroller General, Report to the Congress of the United States on Management of Automatic Data Processing Facilities in the Federal Government, August, 1965, pp. 1-2.

[2] For a complete list of ADP applications in the federal government see: U.S. Bureau of the Budget, The Inventory of Automatic Data Processing Equipment in the Federal Government, July, 1966.

A government wide report on data processing shows policies developed by various agencies as a result of ADP use:

> The Bureau of the Budget has developed, or sponsored the development of, guidelines and policies relating to---
>
> (1) Studies that should be made in advance of the acquisition of equipment;
>
> (2) Selection and acquisition of equipment, with particular reference to purchase-or-rental decisions;
>
> (3) Agency practices in respect of ADP management; and
>
> (4) Sharing of equipment.
>
> In addition, the Bureau (1) published an annual inventory of equipment in the Federal Government; (2) has initiated and led a project to test the feasibility of sharing exchanges; (3) has published a glossary to provide a set of terms that will be commonly understood, and a directory of training opportunities; (4) has established a special panel on standardization (consisting of representatives of the General Services Administration, Bureau of Standards, and the Department of Defense) to strengthen the Government's participation in the program of the American Standards Association; and (5) has created the large Interagency Committee on Automatic Data Processing and a small council to hasten the exchange of experience and to obtain the advice of experienced agencies. By the budget review process and by providing individual consultation, the Bureau has exerted an influence over data processing activities of the Federal Government.
>
> The General Services Administration has negotiated general schedules with equipment suppliers for the acquisition of equipment and has published regulations governing the disposition of excess and surplus equipment. The General Services Administration currently is extending the equipment-sharing concept across the country.
>
> The Civil Service Commission has (1) provided classification and qualification standards for positions related to the operation of computers, (2) provided assistance to agencies in developing aptitude tests, (3) given assistance to agencies faced with employee displacement problems, (4) sponsored and provided extensive training courses, and (5) made special studies of the effect of the computer on Federal employees.
>
> The Bureau of Standards in the Department of Commerce has contributed by conducting experimental work on the design and operation of computers, by providing assistance in designing computer systems and selecting equipment, and by operating a Computer Service Center/Sharing Exchange for the Washington

area.[3]

Despite the efforts of these agencies the ever expanding involvement of the federal government with the computer and the numerous problems that have arisen have caused widespread concern. The same report states:

> The General Accounting Office published a number of reports which focused attention on ADP policies and management practices. The House Government Operations Committee sponsored legislation on the management of ADP. The House Committee on Post Office and Civil Service held extensive hearings and, after publishing a report that raised numerous questions, recommended to the President that a study be made of ADP management. The President, aware of the increasing significance of the computer and the problems raised, directed that the Director of the Bureau of the Budget undertake a comprehensive study of the management of ADP activities of the executive branch and make recommendations for such administrative or legislative actions as may be appropriate.[4]

The result of the numerous investigations and reports was the enactment of Public Law 89-306 on October 30, 1965. This act amended Title I of the Federal Property and Administrative Services Act of 1949 to provide for the economic and efficient purchase, lease, maintenance, operation, and utilization of automatic data processing equipment by federal departments and agencies. Public Law 89-306 did not lessen the Bureau of the Budget's traditional overall policy responsibility and it formally approved the responsibility assignments which the Bureau of the Budget had made earlier by means of Budget Circulars. The Law

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[3] U.S. Bureau of the Budget, Report to the President on the Management of Automatic Data Processing in the Federal Government, March, 1965, p. 5.

[4] Ibid., 6.

also established a revolving fund under the control of the General Services Administration to provide centralized acquisition of all government automatic data processing equipment.[5]

Public Law 89-306 and the establishment of the revolving fund for acquisition of all government automatic data processing equipment provide the framework for the following discussion of the information requirements of the administrator of the fund. Earlier chapters reviewed the criteria for an effective management information system, outlined management's role in the system development, and defined the revolving fund organizational concept within the federal government. To understand the information needs of the administrator it might be helpful to review the problem areas that prompted enactment of this act.

Problem Areas

For a manager to assume the responsibility for the revolving fund under Public Law 89-306, and to provide for the economic and efficient purchase, lease, maintenance, operation, and utilization of automatic data processing equipment within the government, some of the problems that existed previously must be analyzed. The following list compiled by the Bureau of the Budget presents the most important problems.

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[5] U.S. Congress, A Bill to Amend Title I of the Federal Property and Administrative Services Act of 1949 to Provide for the Economic and Efficient Purchase, Lease, Maintenance, Operation, and Utilization of Automatic Data Processing Equipment by Federal Departments and Agencies, Public Law 89-306, 89th Congress, 1st Session, 1965.

1. The diversity of ADP equipment and its use under varying circumstances has raised questions as to the appropriateness of general policies and guidelines applied uniformly to all ADP activities.

2. The great range of possible computer applications---that is, the data processing problems to which to computer may be applied---makes it necessary to develop means for selecting those applications which offer the greatest return. Some applications produce distinct advantages while others are marginal at best.

3. The tremendous effect of system design on the efficiency and effectiveness of computer applications makes it desirable that means be developed for assuring that techniques of high quality systems design are utilized...

4. The selection of equipment requires extensive knowledge of the use for which the equipment is intended and of the performance of available machines. In making the selection, procedures are needed that are not overly expensive, lead to the right choice, and encourage competition.

5. The high cost of computers requires that, wherever feasible, machines already available within the Government be utilized in lieu of acquiring additional capacity...

6. Contracting for computers is made difficult by the lack of standard characteristics of the equipment, the more or less intangible nature of supporting services that are required, and the need for timeliness in the issuance of contracts.

7. Decisions on rental versus purchase involve problems of predicting the economically useful life of equipment under conditions of changing requirements and technology as a basis for determining whether the costs associated with leasing will exceed the costs associated with purchase.

8. The disposal of excess and surplus machines creates problems that will grow as the Government increases its equipment purchases. The problems involve questions of timing, responsibility for choosing the best means by which agencies may accomplish their missions, and economic obsolescence.

9. Maintenance of equipment is a relatively new problem. Rented equipment is ordinarily maintained by the manufacturers. For purchased equipment, policies must be developed for choosing between commercial maintenance procedures and maintenance by Government Employees.

10. The differences among electronic data processing equipment make the transfer of data among machines and systems difficult and expensive. As in most expanding technologies, there are problems of providing the resources for, and of achieving, a satisfactory degree of universally accepted standardization without inhibiting advances in the state of the art.

> 11. There is a need for coordinating research and disseminating findings...
>
> 12. The way in which contractors, performing work for the Government, acquire and use computers is important because there are indications that the amount of work done for the Government on contractor's computers is large. Problems in assuring efficient and economical use, particularly by contractors who are working on a cost-reimbursement basis, have risen because of the need for avoiding the usurpation by the Government of the management responsibilities and authorities of the contractor and also for avoiding procedures that would result in the Government's acquiring expensive equipment that would rapidly become obsolete.[6]

The author feels that the following should be added to this list: (1) an information system which would provide the current, comprehensive, and accurate information necessary for sound management decisions is lacking; (2) criteria with which to appraise the effectiveness of the various systems and installations are nonexistent; and (3) the current procedures for acquiring hardware and software are inefficient.

The revolving fund manager whose mission is outlined by the prologue to Public Law 89-306 has the herculean task of determining the information requirements for accomplishing this mission.

Determination of Requirements

House Report No. 802 gives a clear thumbnail sketch of the General Services Administration's management role in applying the "single purchaser" concept under Public Law 89-306.[7]

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[6] U.S. Bureau of the Budget, Report to the President..., pp. 2-4.

[7] Public Law 89-306 is reproduced in Appendix A.

> Under this arrangement, GSA would have all of the Government's general purpose ADP acquisition money in its pocket and would be in a position, once all aspects of the coordinating program have been fully implemented so that adequate information of prospective Government agency requirements is available, to offer ADP manufacturers firm contracts for specific amounts of ADP equipment. In turn, GSA could reasonably expect to receive some reduction in purchase and lease prices reflecting the magnitude of the Government's acquisition.
>
> The revolving fund established under H. R. 4845 would be primed with capital appropriated directly by Congress and augmented by the unamortized value of the general purpose equipment now in Government agencies which the Government has purchased. GSA would use these funds to acquire by lease or purchase the ADP needed to fulfill the requirements of the various agencies.
>
> Essentially, all Federal agencies would lease equipment from the GSA revolving fund. So far as the agencies are concerned, only the budgetary personnel would know the difference. GSA would acquire the ADP systems selected by the management of the agencies. The agencies would use the equipment as long as they wished, in any manner they saw fit, subject to the general policy and fiscal control of the Bureau of the Budget, the President, and the Congress as normally applied to all agency operations.[8]

The newly appointed administrator of a revolving fund organization such as that created by Public Law 89-306 must start his system development with an analysis of the mission of the fund. A determination of organization policies and objectives must be made and the necessary resources to be devoted to attaining these objectives must be allocated. There must be assignments of responsibility for carrying out each of the subdivisions of the above plan.

The manager must define the key result areas in the

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[8] U.S. House of Representatives, Committee on Government Operations, <u>Automatic Data Processing Equipment</u>, Report No 802, 89th Congress, 1st Session, 1965. pp. 28-30.

organization from which detailed information needs may be derived, and delineate the most important criteria under each key result area. It is this determination that provides the framework upon which a management information system may be developed.

Enumerated below are the quantitative indices or criteria which the author believes the manager should have to evaluate progress and trends in performance toward the goals and objectives established by Congress and the administrator of the revolving fund.

1. Profitability Criteria
2. Equipment Inventory Criteria
3. Equipment Utilization Criteria
4. Procurement Criteria
5. Cost of Operation Criteria
6. Contractual Services Criteria
7. Personnel Development Criteria
8. General Criteria

It should be pointed out that these criteria do not provide the vital operating statistics needed for day to day management activities. In the development of these criteria an attempt has been made to attain simplicity in compilation and presentation, comprehension and adequacy for appraisal and decision making, timeliness, reliability, and significance in the light of the revolving fund's predetermined goals and objectives.[9] These

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[9] Limberg, pp. 104-106.

principles are deemed vital to the development of useful information needs and the ultimate fabrication of an effective management information system. The criteria propounded below are not all encompassing but provide adequate benchmarks from which the most important business decisions may be made by the manager.

Profitability Criteria.--This may imply a surplus creating activity; however, the manager will attempt to operate the fund on a no-profit basis, recovering its actual costs. Attainment of an exact breakeven point is impossible so adjustments to tariffs or charges for services will be made to match revenues and expenses as closely as possible. These adjustments, however, are made only when significant variations between income and expense exist, insignificant profits or losses being carried over to the next fiscal year. The Military Sea Transportation Service is a revolving fund organization which has operated with only a 0.2 percent variance from the breakeven point in the past 10 years.[10]

The methodologies of finance and accounting and some principles of economics permeate the framework of the profitability criteria. The assembly of a quantitative model of operations, such as can be created in this area, is important to the effective management of the fund. The important criteria in this area are break-even point, cash budget, revenue, expenses, demand forecasting and working capital. It is anticipated that the revolving

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[10] U.S. Department of the Navy, Military Sea Transportation Service, Navy Industrial Fund Handbook for the Military Sea Transportation Service, NAVEXOS P-1280, p. 3.

fund will be primed with a $10 million capital appropriation at the outset with $20 million augmentations annually through fiscal 1973.[11] After this date the fund should be self-sustaining.

Equipment Inventory Criteria.--When the revolving fund is established it is presumed that all general purpose equipment now in government agencies, which the government has purchased, will be capitalized on the books of the fund organization. Most business organizations have a substantial part of their assets represented in inventory, and effective inventory control procedures are essential to insure effective management. Inventory management in this organization takes on a more complex meaning than in most business organizations since it deals with hardware and software, configuration and application, purchased and leased equipment, in use and surplus equipment, geographical area and ownership status, purchase cost or rental fee, and equipment maintenance.

The important criteria in this area are hardware inventory, software inventory, surplus inventory, quantity of new equipment, delivery time for new equipment, average life of purchased equipment, cost savings resulting from standardization of systems, applications or purposes for which equipment is used, and maintenance costs (contract or own force).

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[11] Interview with Leo L. Miller, Data Processing Systems Coordinator, Program Development and Assistance Division, General Services Administration, March, 1967.

Equipment Utilization Criteria.--The General Accounting Office has consistently reported the large amount of unused automatic data processing equipment capacity existing within the federal government.[12] This is becoming increasingly prevalent as the percentage of computers owned by the government increases. The maintenance of accurate and timely equipment utilization information will enable the manager to provide leadership in time sharing and joint utilization projects. These information criteria could be grouped under equipment inventory but it is felt that their importance is significant enough to classify them under a separate key-result area. The important criteria in this area are operating time analyses, time shared, joint utilization projects, cost savings, capacity utilization (owned and leased), sharing exchanges, transfer pricing (prices for services), productive and unproductive time.

Procurement Criteria.--The big issue in the management of electronic data processing in the government is: Should computers be purchased or should they be rented? The resolution of this question can only result after solving a larger problem: How long can a given computer be used advantageously in the government? Policies and criteria governing these decisions are knotty management problems which must be considered as they affect the individual agency and the government as a whole. The fund

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[12] U.S. Comptroller General, Report to the Congress of the United States on Management of Automatic Data Processing..., pp. 61-67.

manager must continue to seek improved contract terms and conditions with emphasis on discounts on volume procurements, optional use periods (including unlimited use), supporting services, uniformity in contracts, deposits on options, competitive bidding, standard purchase specifications, and the maintenance of current data on the characteristics and performance capabilities of all items of commercially available general purpose electronic data processing equipment. Nelson and Shelton of Rand Corporation divide the procurement function into four main categories of information necessary to accomplish procurement: requirements data, item procurement characteristics, production data, and fund availability.[13] The important criteria for evaluating this area are customer satisfaction, timeliness, cost savings (resulting from volume buying, use of surplus equipment, better contracts, standardization, etc.), procurement contracts, rental contracts, quality reputation, service performance, price trends, cost-procurement leadtime relationships, rate ranges, negotiated contracts, and competitive bids.

Cost of Operation Criteria.--The segregation of all income and expense in connection with the operation of the fund provides a means for adequate accounting of the stewardship. This is vital to protect the integrity of the working capital

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[13] H.W. Nelson and W.V. Shelton, "Information Requirements for Integrated Supply Support: An Information Analysis Case Study" (Unpublished paper prepared by Rand Corporation, Santa Monica, Calif., January, 1964), pp. 48-49.

and to maintain the cost per service rendered as low as possible. The cost per service will depend upon how economically the fund management is performed. Emphasis is placed on management's need for information, rather than on accounting as an end in itself. A double-entry accrual and cost accounting system is recommended with cost accounting on a cost center and, often, job order basis. Each cost control center would submit three types of reports: accounting reports, which provide the historical data needed for external reporting; control reports, consisting of selected financial and operating data which provide management with a continuing and systematic review of trends and current developments; and special reports which provide the status of problem areas uncovered by the control reports. The important criteria for evaluating the cost of management's performance are salaries and wages, facilities costs, cost of capital, equipment and supplies and other administrative expenses.

Contractual Services Criteria.--Over $139 million is paid contractor organizations for ADP services annually.[14] This, coupled with the large amount of unused capacity reported annually, presents a real challenge to the revolving fund manager and reinforces the need for an effective sharing program. The use of contractor services usually occurs during peak workloads and it is to the agencies' advantage to obtain assistance from outside, rather than augmenting its own staff for a short

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[14] U.S. Bureau of the Budget, The Inventory of Automatic Data Processing Equipment..., pp. 10-12.

period of time. Contractor services are also utilized for programming and systems development when the talents of the agency are lacking either as to kind, quantity, or time needed. The important criteria for evaluating this area are contractual costs for computer time (and its purpose), data preparation and conversion, programming, system design, consultant work, equipment operations, equipment maintenance, and training.

General Criteria.--These criteria have a wide range of application among all the key-result areas, and their primary purpose is to appraise the manager of performance in these areas. These criteria, usually applied in specific management situations to denote trends, comparisons, accomplishment or percentages, will vary, more so than those of the other key result areas, according to the discretion of individual managers. Some of the criteria in this category are forecasting accuracy, surplus utilization effectiveness, equipment reliability, organization versatility, public responsibility, equipment utilization effectiveness, personnel efficiency, standardization progress, system cost savings, and impartial surveys and audits.

Personnel Development Criteria.--These criteria measure the effectiveness of a personnel development program. Management must determine the classifications and the quantities of abilities that are and will be required by the organization. These abilities must be explicitly identified if these criteria are to be useful. Some examples of these criteria are experience, promotable personnel

training, education, responsibility, ability, turnover, health, ambition, initiative, absenteeism, motivation, morale, incentives, safety, employee security, community participation, travel, public service, and stable employment.

It has not been the intention in this chapter to provide top management with a panacea for all its decision-making responsibilities. It has provided a framework of significant elements from which information can be derived. This framework is intended only as an aid to the executive who must place his own values on information. Adrian McDonough says, "Information is used as the label for evaluated data in a specific situation. Information is the measure of the value of a message to the decision maker."[15] It can be seen from this approach that only the manager can produce these measures of value in a meaningful form to enable him to make decisions and evaluate resultant actions. The more specific his area of identification the more meaningful will be his information.

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[15] McDonough, Information Economics and Management Systems., p. 200.

CHAPTER V

MANAGEMENT"S CHALLENGE: REVIEW AND SUMMARY

At this point in the history of this country, over fifty percent of the labor force is classified as white collar. With improving technology of production it is apparent that these white collar personnel who gather and use information will comprise an ever larger percentage of the total labor force.[1] The mounting need to control paperwork and clerical costs has led to a rapid growth of management information systems.

Most organizations are not effectively using the computer. Few people besides the computer operator or programmer can communicate with the machine. Management at all levels has failed in its responsibility to make data processing a management oriented process. It is inconceivable that management would allow a costly computer installation to be used for clerical programs and statistical analyses and overlook the development and implementation of an internal system which would provide sound business direction.

The general benefits of data processing to an organization are understood by most executives but the specific benefits which can be gained by an advanced management information system are not widely known. The reasons for the slow development are the

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[1] McDonough, Management Systems..., xiv.

use of automatic data processing exclusively for limited paperwork projects and the reluctance on the part of management to commit funds to a project with any objectives except those that effect immediate cost reduction. The tendency has been to load the computer with government, legal, and financial requirements at the expense of planning and control. The immense benefits to be gained by the use of electronic data processing equipment to develop a real management system are too frequently lost in a maze of minor projects.

For the most part, system studies have been equipment-oriented instead of systems-oriented. The analysis is made in terms of computer runs and times, sizes of files, characteristics of equipment, etc., instead of the requirements of management for reports and information. The basic processes of management must be built into the management information system. The trepidation with which many managers approach systems analysts and programmers to lay bare their requirements frequently causes an organization to retain its archaic system at the expense of an effective system that could be devised with the mutual cooperation of managers, systems analysts and programmers.

It has already been pointed out that systems people must be more profound students of management, but by the same token, managers have a responsibility to learn the language of the computer. In order for close liaison to exist among managers, analysts, and computer programmers, the manager must be familiar

with the technical jargon used by the specialists as well as the basic capabilities and limitations of the data processing installation. Without this knowledge, management is poorly equipped to assert its requirements for an effective system.

It is not possible to manage entirely by mathematical formula; however, the decision-making process governing operational functions (i.e., functions with a definable flow of work) is usually well structured and is susceptible to programming for a computer. In order to achieve an effective system, middle management decisions, for the most part, must be well structured and free of interpersonal bias. The external elements affecting the operations of an enterprise (e.g., economy, government regulations, labor unions, and competition) are ill-structured and difficult, if not impossible, to include in a model and, therefore, to program.

As one moves past the operating level on the decision-making spectrum, human intuition and judgment become increasingly important, the level of systems work grows more difficult, and the determination of explicit information requirements more valuable. It is believed that management, particularly in the operating divisions, has not furnished the impetus to program all that is well structured and is thereby not assembling and correlating all the data available to top management.

J. D. Gallagher has compiled a list of eleven questions that should be answered before a management information system

can be considered effective. The questions are reprinted below because they point out some of the weaknesses in many systems designs:

> 1. Are lines of responsibility and scope of decision making authority clearly defined and documented?
> 2. Does the information the individual manager receives meet his specific needs?
> 3. Does it reflect the nature of his responsibilities and scope of decision-making authority in the organization?
> 4. Is the reports system, with the individual reports, selective and relevant in nature, or must the executive laboriously extract pertinent information?
> 5. Does the report use effective presentation techniques?
> 6. Is information stated in the language of the user?
> 7. Is the original formally stated use of the report in balance with its actual use?
> 8. Is the accuracy of the information in reasonable balance with its stated or actual use?
> 9. Timeliness?
> 10. To what extent do we find departmental duplication in the reports system, and duplication in the maintenance of information files and records?
> 11. To what extent have decisions of a recurrent nature been identified, and to what extent are these decisions fairly automatic, or conditioned, responses to information inputs? Study carefully the possible use of data processing system for exception reporting.[2]

This paper has been highly critical of management, but in its defense the resolution of management information processing terminology with theory and practice can not be expected to take place immediately. If management information processing is to develop as a scientific discipline, then more systematic research in the management of automatic data processing equipment and the application of systems analysis must take place. The evolution is not taking place fast enough; modern inventive genius outstrips

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[2] Gallagher, 130-131.

the genius for effectively organizing and managing.

The discussion of revolving fund organizations within the federal government shows a financial segregation of activities that generate revenues similar to that of commercial enterprises. Within this type of organization structure the author selected a fund that Congress established to manage automatic data processing equipment within the federal government. A set of quantitative indices by which the revolving fund manager can evaluate progress and trends in performance toward the fund's long-term goals and objectives were developed.

The criteria were developed with only minimal regard as to whether their generation would be technically or economically feasible, and without regard to the current existence or non-existence of acceptable criteria in each of the areas. In some instances where quantitative standards do not exist, the key result area criteria may not prove to be as useful as desired. Progress may be evaluated in this area, however, by comparing present with past performance of the same function. The aim here was to have the key result areas and their most important criteria fit the level of responsibility of the manager and support his leadership responsibilities.

In the course of this paper many knotty management problems were passed over lightly. The detailed customer reporting system to feed the needed information to the fund manager was not considered insignificant. The problem of transfer pricing, which is the

bane of most businessmen's existence, is a major one. The recourse that an agency customer has if he does not wish to procure ADP equipment through the revolving fund must be reconciled. And the resistance that the fund administrator will encounter in the political arena will be resolved only through much debate and compromise.

There are an infinite number of ways to classify criteria for management purposes and the selection of the most meaningful criteria is a primary requisite for the successful manager. In this paper the illustration used was the revolving fund manager but it could as easily have been the manager of any other organization, civilian or military.

It should not be assumed that the criteria, once selected by the manager, are fixed. The system and the criteria upon which it is built must be flexible and susceptible to rapid modification to meet the changes in information needs of management. There are no immutable formulas.

The early chapters of this paper were devoted to the examination of management information systems as viewed by industrial leaders, management consultants, government officials, and authors of books on management. Some differences of opinion emerged on the structure of middle management in the future; however, there was unanimous agreement on the advocating of better information handling and more effective management participation. Garrett comments thus:

> Business is a complex information system, but we have yet to organize an effective approach to handling the flow of information within business. Our limitation is not attributable to the computer system, for the capability of machines has far outstripped our knowledge of how to use them to optimum advantage. What we lack is a fundamental understanding of the very business processes with which we have lived for many years. It is a truism that only when we attempt really to understand the functioning of a business system, in order to utilize most effectively our new technology, do we discover how little we know of our business operations and of ourselves. Systems discipline will ultimately come from improved understanding of control concepts and control opportunities. It will spring, too, from a more perceptive appreciation of organization and organizational relationships, of the flow of information and of how it should be used.[3]

To catch up, managers must displace their fear of automation and have patience and a belief in the long-term advantages that can accrue from management information systems. They must participate in the sound engineering of the system and insure that it is a management-oriented process. Despite automated systems, managers will still require imagination, creativity, and leadership to meet the challenges ahead.

Douglas C. Englebart says:

> Man's population and gross product are increasing at a considerable rate, but the complexity of his problems grows even faster. And the urgency with which solutions must be found becomes steadily greater in response to the increased rate of activity and to the increasingly global nature of that activity.[4]

To meet the many challenges ahead, management must have a faster reaction time. An effective management-oriented information system can provide this reaction time.

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[3] Garrett, 46.

[4] Douglas C. Englebart, "A Conceptual Framework for the Augmentation of Man's Intellect," Vistas in Information Handling, eds. Paul W. Howerton and David C. Weeks, (Washington, D.C.: Spartan Books, 1963), p. 2.

APPENDIX A

Public Law 89-306
89th Congress, H. R. 4845
October 30, 1965

AN ACT

To provide for the economic and efficient purchase, lease, maintenance, operations, and utilization of automatic data processing equipment by Federal departments and agencies.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That title I of the Federal Property and Administrative Services Act of 1949 (63 Stat. 377), as amended, is hereby amended by adding a new section to read as follows:

"AUTOMATIC DATA PROCESSING EQUIPMENT

"Sec. III. (a) The Administrator is authorized and directed to coordinate and provide for the economic and efficient purchase, lease, and maintenance of automatic data processing equipment by Federal agencies.

" (b) (1) Automatic data processing equipment suitable for efficient and effective use by Federal agencies shall be provided by the Administrator through purchase, lease, transfer of equipment from other Federal agencies, or otherwise, and the Administrator is authorized and directed to provide by contract or otherwise for the maintenance and repair of such equipment. In carrying out his responsibilities under this section the Administrator is authorized to transfer automatic data processing equipment between Federal agencies, to provide for joint utilization of such equipment by two or more Federal agencies, and to establish and operate equipment pools and data processing centers for the use of two or more such agencies when necessary for its most efficient and effective utilization.

" (2) The Administrator may delegate to one or more Federal agencies authority to operate automatic data processing equipment pools and automatic data processing centers, and to lease,

purchase, or maintain individual automatic data processing systems or specific units of equipment, including such equipment used in automatic data processing pools and automatic data processing centers, when such action is determined by the Administrator to be necessary for the economy and efficiency of operations, or when such action is essential to national defense or national security. The Administrator may delegate to one or more Federal agencies authority to lease, purchase, or maintain automatic data processing equipment to the extent to which he determines such action to be necessary and desirable to allow for the orderly implementation of a program for the utilization of such equipment.

" (c) There is hereby authorized to be established on the books of the Treasury an automatic data processing fund, which shall be available without fiscal year limitation for expenses, including personal services, other costs, and the procurement by lease, purchase, transfer, or otherwise of equipment, maintenance, and repair of such equipment by contract or otherwise, necessary for the efficient coordination, operation, utilization of such equipment by and for Federal agencies: Provided, That a report of equipment inventory, utilization, and acquisitions, together with an account of receipts, disbursements, and transfers to miscellaneous receipts, under this authorization shall be made annually in connection with the budget estimates to the Director of the Bureau of the Budget and to the Congress, and the inclusion in appropriate acts of provisions regulating the operation of the automatic data processing fund, or limiting the expenditures therefrom, is hereby authorized.

" (d) There are authorized to be appropriated to said fund such sums as may be required which, together with the value, as determined by the Administrator, of supplies and equipment from time to time transferred to the Adminsitrator; shall constitute the capital of the fund: Provided, That said fund shall be credited with (1) advances and reimbursements from available appropriations and funds of any agency (including the General Services Administration), organization, or contractor utilizing such equipment and services rendered them, at rates determined by the Administrator to approximate the costs therof met by the fund (including depreciation of equipment, provision for accrued leave, and for amortization of installation costs, but excluding, in the determination of rates prior to the fiscal year 1967, such direct operating expenses as may be directly appropriated for, which expenses may be charged to the fund and covered by advances or reimbursements from such direct appropriations) and (2) refunds or recoveries resulting from operations of the fund, including the net proceeds of disposal of excess or surplus personal property and receipts from carriers and others for loss of or damage to property: Provided further, That following the close

of each fiscal year any net income, after making provisions for prior year losses, if any, shall be transferred to the Treasury of the United States as miscellaneous receipts.

" (e) The proviso following paragraph (4) in section 201 (a) of this Act and the provisions of section 602 (d) of this Act shall have no application in the administration of this section. No other provision of this section shall be applicable in the administration of this section.

" (f) The Secretary of Commerce is authorized (1) to provide agencies, and the Administrator of General Services in the exercise of the authority delegated in this section, with scientific and technological advisory services relating to automatic data processing and related systems, and (2) to make appropriate recommendations to the President relating to the establishment of uniform Federal automatic data processing standards. The Secretary of Commerce is authorized to undertake the necessary research in the sciences and technologies of automatic data processing computer and related systems, as may be required under provisions of this subsection.

" (g) The authority conferred upon the Administrator and the Secretary of Commerce by this section shall be exercised subject to direction by the President and to fiscal and policy control exercised by the Bureau of the Budget. Authority so conferred upon the Administrator shall not be so construed as to impair or interfere with the determination by agencies of their individual automatic data processing equipment requirements, including the development of specifications for and the selection of the types and configurations of equipment needed. The Administrator shall not interfere with, or attempt to control in any way, the use made of automatic data processing equipment or components thereof by any agency. The Administrator shall provide adequate notice to all agencies and other users concerned with respect to each proposed determination specifically affecting them or the automatic data processing equipment or components used by them. In the absence of mutual agreement between the Administrator and the agency or user concerned, such proposed determinations shall be subject to review and decisions by the Bureau of the Budget unless the President otherwise directs."

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